MACHINERY.

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TOOLS FOR MACHINING PULLEYS.

DETAIL SKETCHES OF TOOLS AND FIXTURES FOR USE IN THE TURRET LATHE.

JOSEPH VINCENT WOODWORTH.

The set of tools of which sketches are here shown were designed for finishing countershaft clutch pulleys in the turret lathe and have been very successfully used for this purpose. It was desired to turn out the pulleys in large quantities, and to have the work accurately done, making them duplicates so far as their finished dimensions were concerned. The tools were so constructed that the pulleys could be finished complete at one setting.

The type of pulley which this particular set of tools was designed to machine is shown in the two views in Fig. 1, and consists of a six-arm pulley of a common type. The points to be machined are as follows: The hole was to be bored and reamed and one end of the hub faced; the sides of the rim were to be faced, and an interior portion of the rim bored and finished on a very slight taper, as shown, for the friction or rubbing surface of the clutch; and, finally, the face of the pulley had to be crowned and finished.

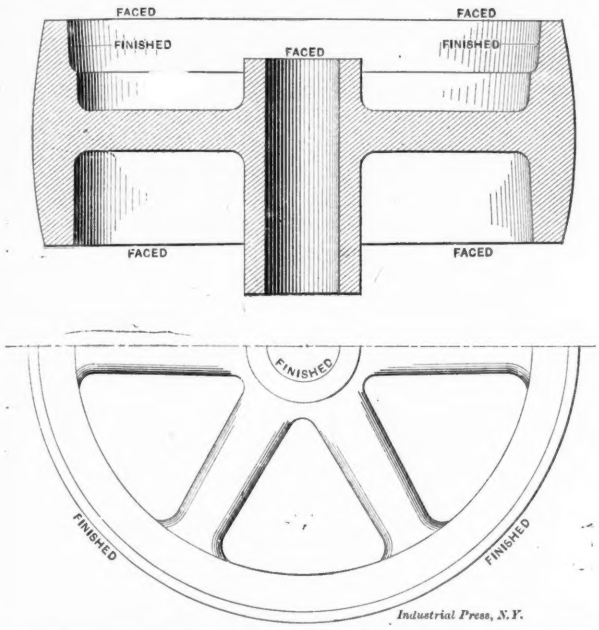


Fig. 1. Countershaft Clutch Pulley, showing Surfaces to be Machined.

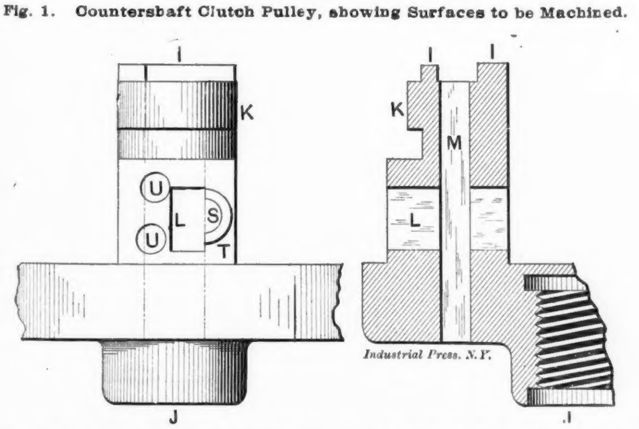


Fig. 3. Details of Body of Chuck, showing Broached Holes for Jaw and Wedge.

In order to accomplish all these operations at one handling of the piece, all the tools had to be specially constructed for the purpose. They consisted of a chuck for holding the work while being machined, a combination boring and hub-facing tool, a turret fixture for boring and finishing the clutch portion, and a special compound slide rest, with cutting tools at the back and front.

Two views of the chuck are shown in Fig. 2, and the several parts of the chuck appear in detail in Figs. 3 to 7, inclusive. The chuck so holds the work that all points to be machined are easily accessible to the cutting tools. There are nineteen parts in the chuck. The body is a forging of mild steel, and is bored and threaded at the back to fit the spindle of the turret lathe. There are three projecting lugs or false jaws *I I*, as shown, and the faces of these were turned off to form three even supports for three of the pulley arms. The outside surfaces *K K* of the lugs were turned to a suitable diameter for the purpose of locating the pulley in a central position by means of the inside of the pulley rim which comes in contact with these surfaces *K K* when the pulley is held in the chuck. The surfaces *K* and *I* of each lug, therefore, determine the position of the pulley with sufficient accuracy for machining while the arms are clamped securely by the jaws *O O*.

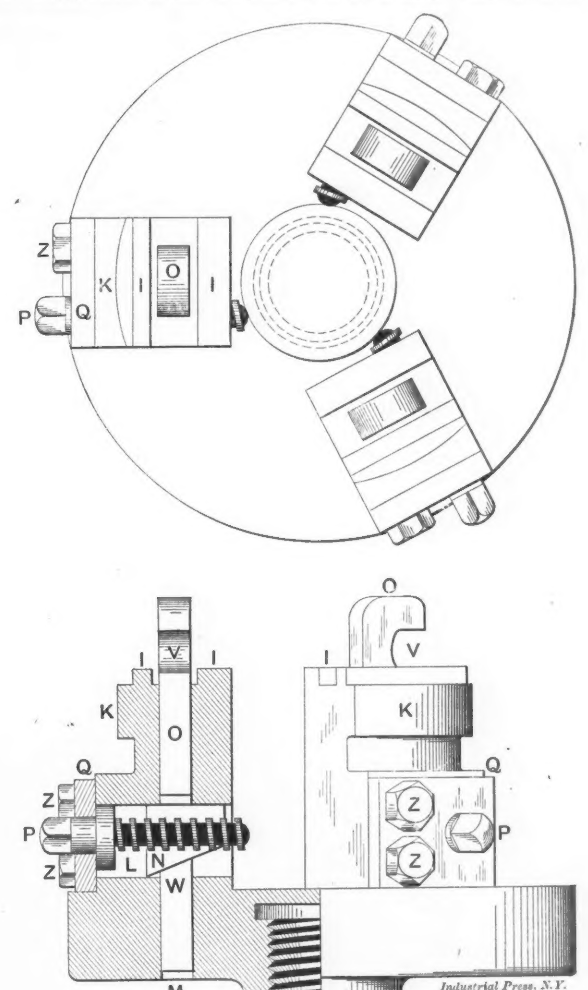
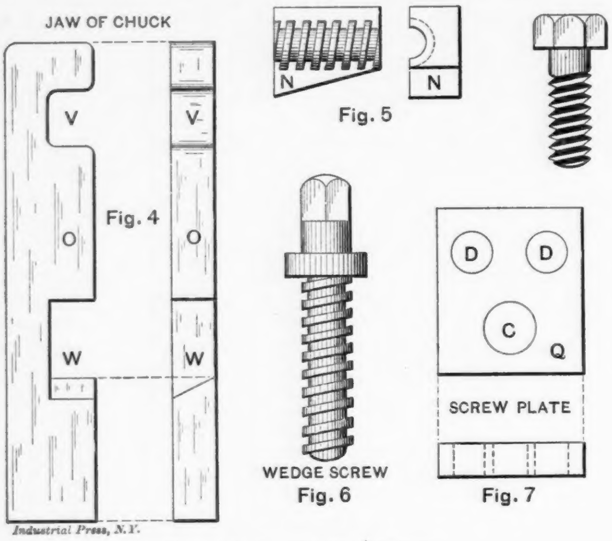


Fig. 2. Chuck for Use in Machining the Pulley, Fig. 1. It locates the Pulley in its Proper Position and Holds it so that all the Surfaces can be Finished at One Operation.

The construction and operation of the chuck will be clearly understood from the engraving, and it will be seen that the pulleys can be clamped in position or removed very readily. The three jaws *O O* which grip the spokes of the pulley and

draw them against the faces of the false jaws, are moved in or out as required, by simply tightening or loosening the wedge screws *P*, which raise or lower the wedges *N*, as shown in the sectional view of Fig. 2. In making the chuck it is



Figs. 4 to 7. Details of Chuck.

interesting to note that the finishing of the rectangular holes *L* and *M*, Fig. 3, in which slide the wedges *N* and jaws *O*, was accomplished by the use of broaches of the type shown in Fig. 13. For such work the broach should be constructed with very coarse teeth on the lower end to take out the bulk of the stock. It will be noticed that the teeth on the two ends of the broach are so inclined as to give shearing cuts in opposite directions, the object of this being to break off the chips as the broach passes through the work. The upper end of the broach is left perfectly straight for about two inches and serves as a sizer. The broaching of the holes is accomplished by forcing the broach completely through them under the power press. The machining of the other parts of the chuck presents no difficulties and will be understood by reference to the figures. All parts except the body of the chuck are of tool steel and all wearing surfaces were hardened and tempered.

The combination boring and hub-facing tool holder is shown in Fig. 12. After the hole in the pulley is bored and the hub faced by this tool, it is finished by the small chucking reamer and by a finishing reamer of the floating type, to insure the hole being true and round.

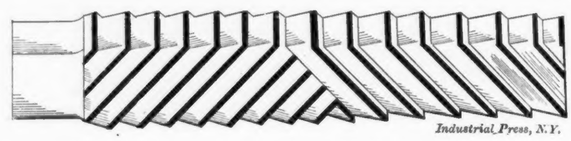


Fig 13. Type of Broach used for Finishing the Holes for the Wedges and Jaws in the Chuck.

The special turret tool for finishing the clutch portion of the pulley is shown in Fig. 8, and details of the parts in Figs. 9, 10 and 11. The three cutting tools are held in dovetailed channels finished to an angle of three degrees with the center line of the fixture, this being the angle of the clutch surface on the interior of the pulley rim. Having the grooves finished at this angle makes it easier to set the cutters correctly and as the cutters are held by clamping, they can be adjusted to remove the right amount of metal.

In Fig. 14 is a plan view of the special compound' slide rest, with the cutting tools in position. This slide rest consists of the main casting *A*, which is fitted to the carriage of the turret lathe, replacing the cross slide, of the compound rest *B* and *C* in which the gashing or roughing tools are held, and of the face crowning and finishing tool fastened within the main casting *A*, in a dovetailed groove at the back, as clearly

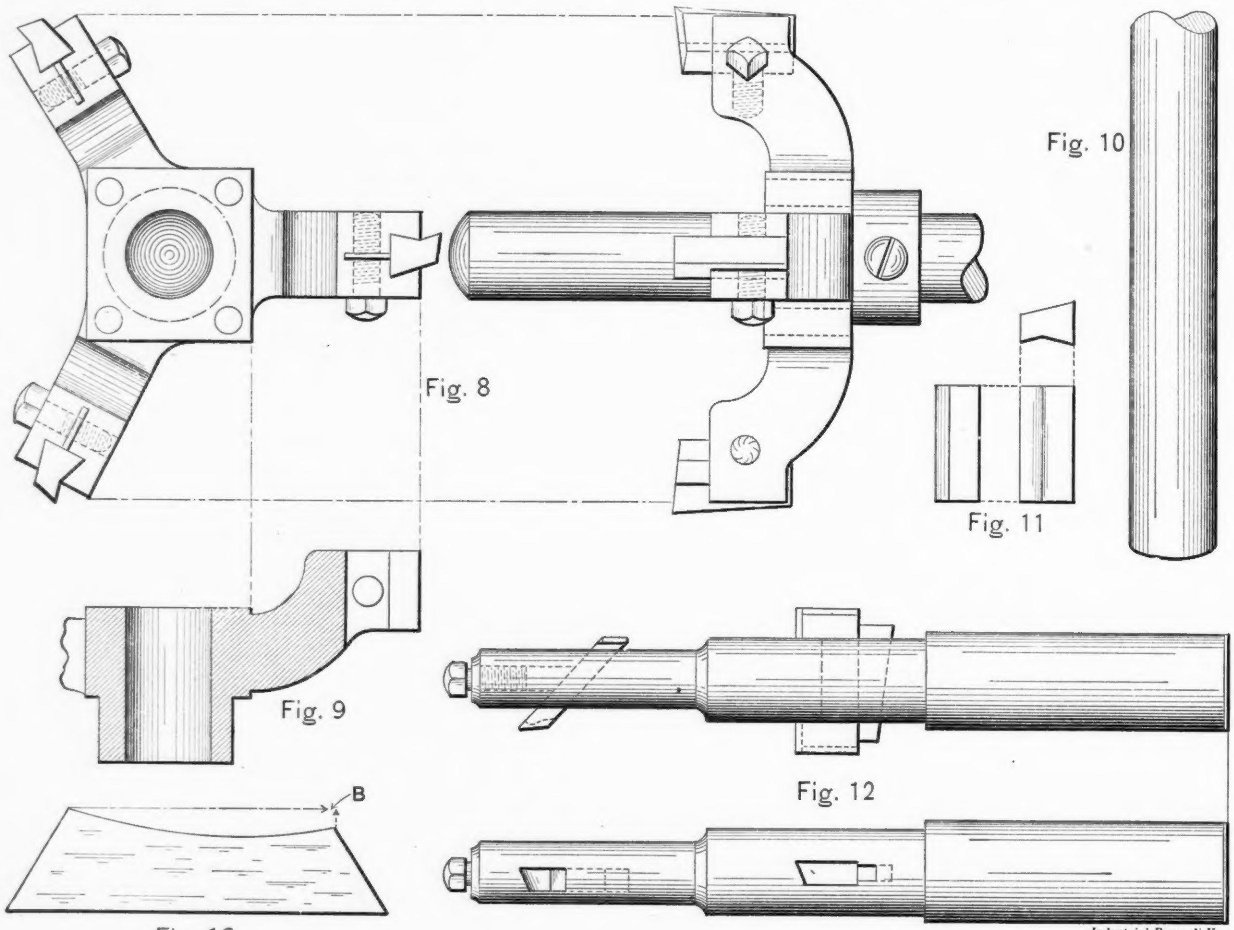


Fig. 8. Turret Tool Holder for Finishing Taper Surface on inside of Pulleys.
Fig. 9. Cross Section of Holder showing Method of Fastening the Cutting Tools.
Fig. 10. Leading Stud which Enters the Finished Hole in the Pulley and Braces it while the Taper Portion is being Finished.
Fig. 11. Cutting Tool.
Fig. 12. Combination Holder for Boring and Hub-facing Tools.
Fig. 16. Crowning Tool, showing Manner of Finishing the Formed Face.

indicated in Fig. 14. There are seven roughing tools and two side tools, located in channels in the slide C and fastened by set-screws in the strap D—the six short ones for gashing the scale and roughing off the face, and the other two for facing the sides of the pulley rim. The face crowning and finishing tool is located in such a position in the body plate A that its gashing or roughing tools are next run in and fed sideways about 3-16 inch, thus removing all the scale and the sides of the pulley are faced by the side tools, all that is necessary being to clean them up.

To crown and finish the pulley the whole slide rest is fed out by the cross-feed screw of the carriage until the entire

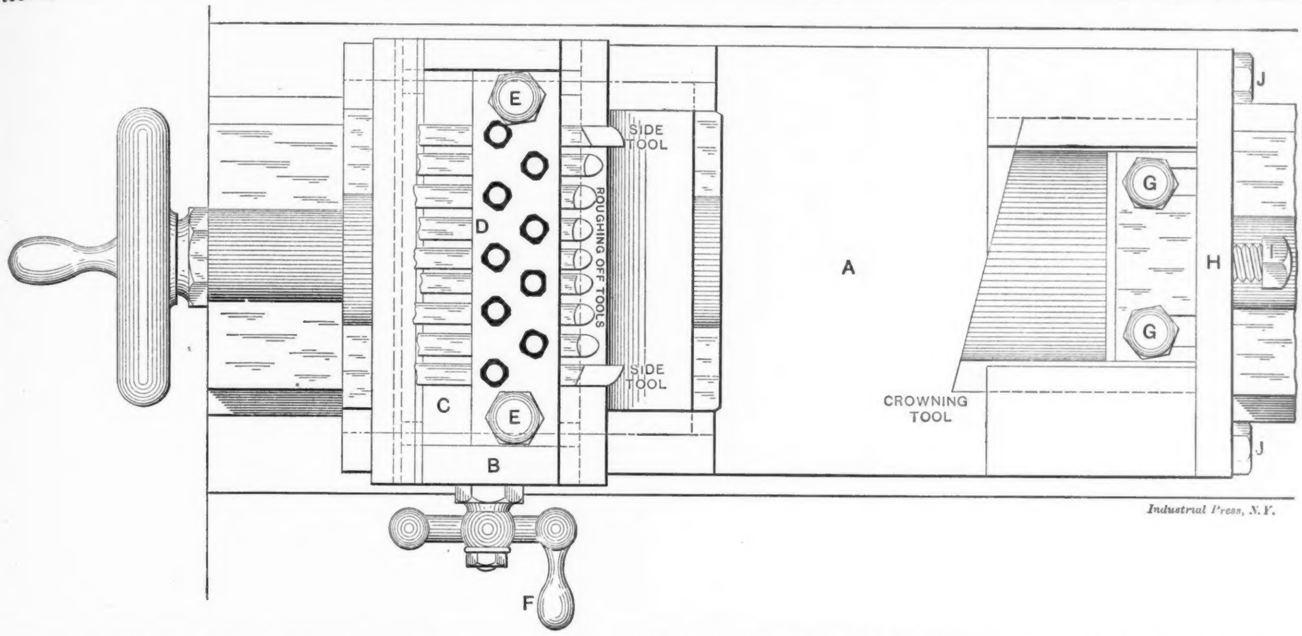


Fig. 14. Plan View of Special Compound Slide Rest complete, with Tools in Position for Roughing off the Scale, Finishing the Sides and Crowning the Face of the Pulley.

cutting edge will operate in a line tangent to the periphery of the pulley; and as the tool is designed to take a shearing cut, the metal is removed progressively from one side of the pulley to the other, thus reducing the strain and the tendency to chatter. A plan of the slide rest is given in Fig. 14, and in Fig. 15 is the elevation, which also shows the manner of holding the pulley in the chuck.

Referring to Fig. 15, it will be seen that the pulley is secured in the chuck by slipping the spokes into the notches cutting edge of the crowning and finishing tool has passed beneath it and finished and sized it to the shape and size required. The use of this set of tools insured the exact duplication of the work produced at a low cost.

There is one point that must not be lost sight of, when constructing a forming and finishing tool of the type shown here, for crowning the pulley. As the face or cutting edge is finished and ground so as to take a shearing cut, and the tool is located in such a position in the main casting as to give it

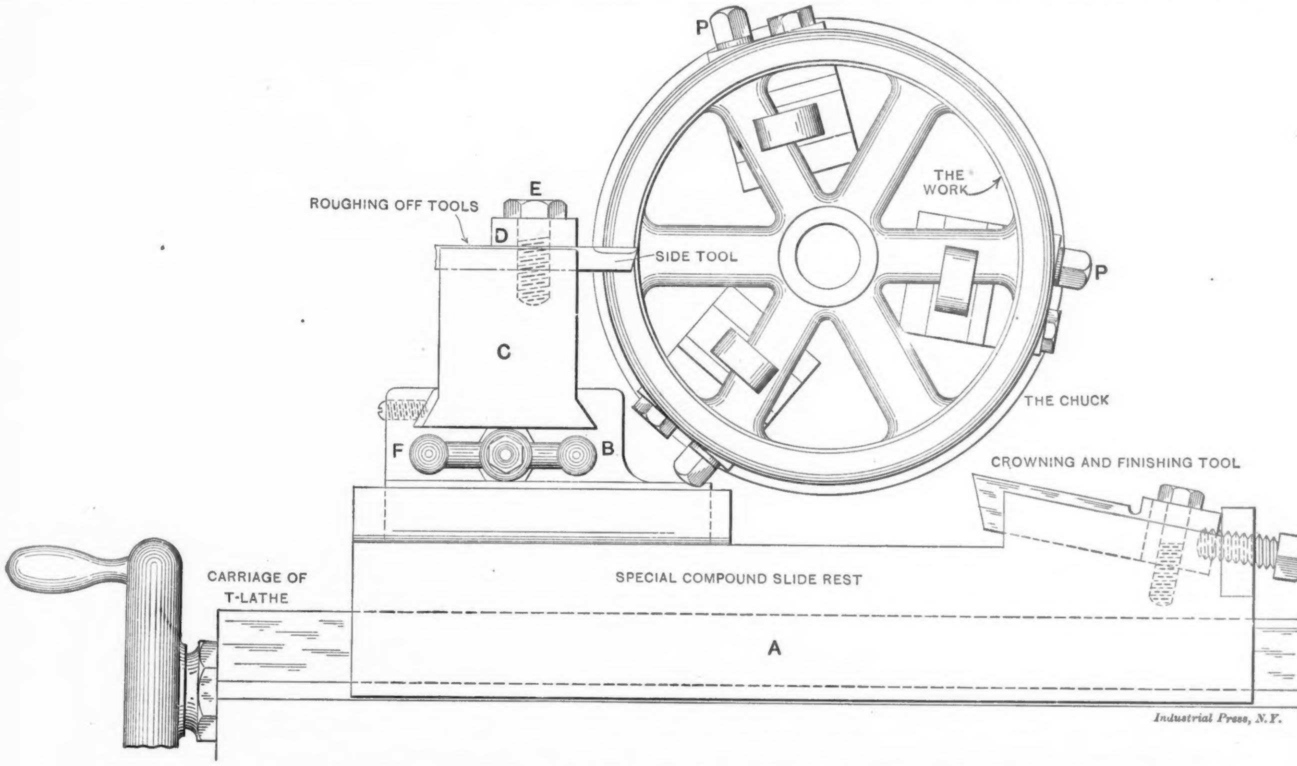


Fig. 15. Manner of Holding Pulley in the Chuck and use of the Special Compound Slide Rest for Finishing the Face and Slides.

of the jaws and tightening the wedge screws P so as to draw the spokes tightly against the locating faces, as shown. The hole in the pulley is then bored and the hub faced by the combination tool shown in Fig. 12, after which the clutch portion is finished by the fixture shown in Fig. 8, the leading stud supporting the work when it is being machined, and remains in the hole until the pulley has been finished. The face the required clearance angle, the forming face must be finished as shown at B, Fig. 16. As the tool is set at an angle with the face of the pulley, in order to produce the shape desired one side must be considerably higher than the other, as at B. This should be figured out and a template made, according to the degree of clearance given and the amount of shear to the cutting face.

NOVEL TRAVELING CRANE ARRANGEMENT

PART OF THE SIDE OF THE SHOP CAN BE MOVED TO ENABLE THE CRANE TO PASS OUTSIDE.

The main machine shop of Mackintosh, Hemphill & Co., Pittsburg, Pa., the well-known builders of heavy rolling mill engines and machinery, is L-shaped, one branch of the L being mostly given up to machine tools and the greater part of the other to the erecting floor. Each section of the L is served by heavy traveling cranes which make the handling of the heaviest castings within the shop a comparatively simple matter, but as the arrangement of the shop buildings and those on adjacent property is such that a railway switch could not be carried into the shop without considerable sacrifice, the problem of crane arrangement so as to admit of economical handling of parts for railway shipment was one that required considerable thought and designing before it was satisfactorily solved.

The solution is as simple as it is novel and is plainly shown in the three accompanying cuts, Figs. 1, 2 and 3. A narrow street separates Mackintosh, Hemphill & Co.'s shops from the adjacent buildings, and through it the railway switch is laid. The switch runs parallel to the branch of the L given

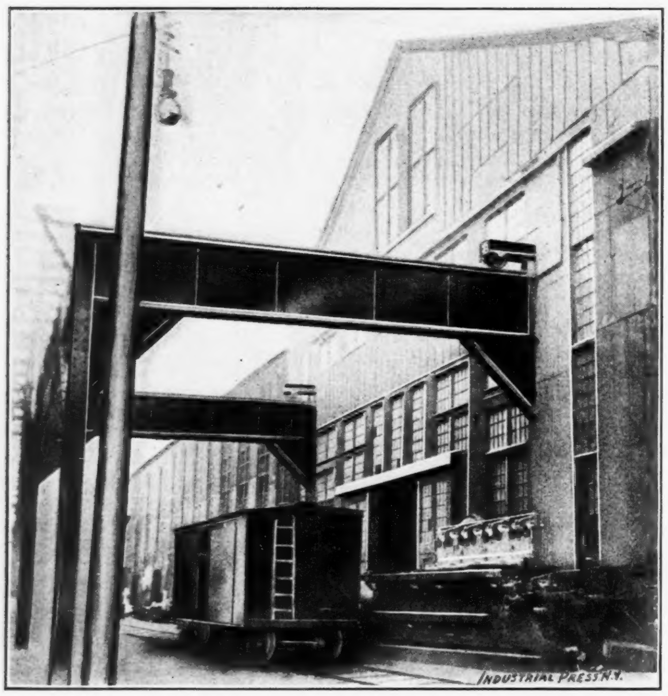


Fig. 1. Showing how the Crane Tracks extend through the Side of the Shop.

up to the erecting floor; consequently the crane tracks for the machine floor run at right angles to the railway switch. These tracks are carried over the switch as shown in Fig. 1 so that the crane can travel outside of the building and deposit its load directly on a flat car. But this makes necessary an opening of considerable size in the end of the shop which would be incompatible with keeping the interior at the proper temperature for comfortable working in winter. It was, therefore, necessary to provide the opening with a door which can be readily opened when the crane is moved out over the switch and immediately closed when the necessity for its being open is removed. The door closing the opening, which is shown closed in Fig. 1, is carried on trucks at the ends, the same as the crane, which travel on the same tracks. In Fig. 2 the door is shown moved over to the left and the opening unobstructed for the passage of the crane. Fig 3 shows the crane outside of the shop, with the hook directly over the box car which happened to be standing on the switch at the time the photographs were taken.

The manner of moving the door is simple, the crane being utilized for the purpose. When the door is to be opened the crane pushes it over to the position shown in Fig. 2, and when it is to be closed the crane engages it by means of two latches which draw the door after the crane to the opening and then are disengaged, leaving the opening closed. It will be observed that the opening in the end of the shop communicates by a narrow slit with that made by the sliding door beneath. The chains pass through the narrow opening and the load is carried through the lower door. The opening and closing of the crane runway is accomplished so easily that it is regarded as being of very little trouble, even in

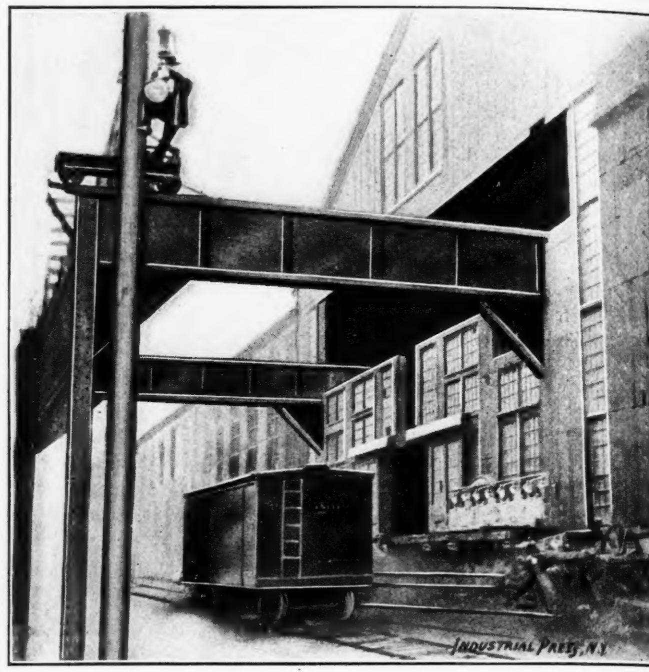


Fig. 2. The Side of the Shop is on Wheels and can be Moved Out on the Crane Tracks.

winter, when it is quite necessary to close it at each trip of the crane to the outside of the shop when loading a car on the switch. The operations of opening and closing the door, being practically automatic, interfere but little with the crane operator's other duties.

The foundry is located beyond the machine shop and castings from it may be carried directly through the machine

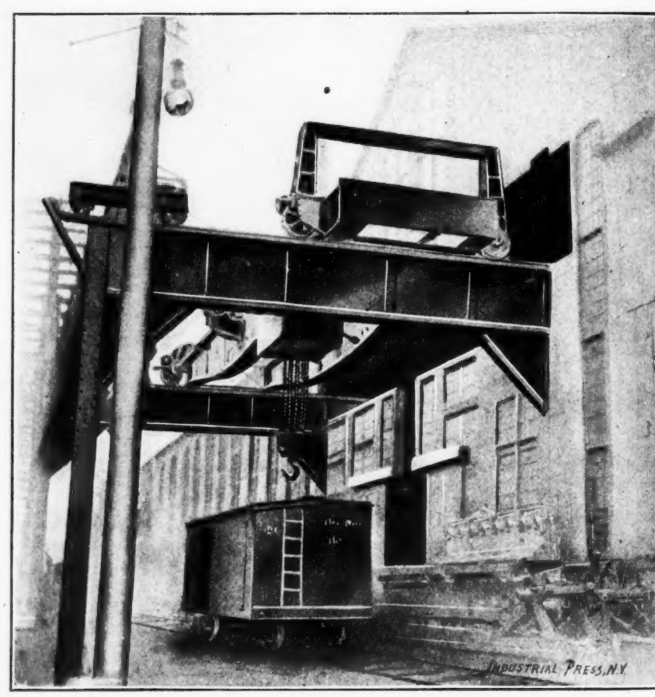


Fig. 3. Showing how the Crane passes through the Opening in the Side of the Shop.

shop for shipment or may be machined and then shipped without traversing the same route twice. If, as in the case of engines and rolling mills, it is necessary to transport the parts to the erecting floor for assembling, a transfer is made at right angles from one traveling crane to the other and then back again when the parts are ready for shipment The adaptation of an old plant to modern manufacturing methods

has thus been very well worked out without entailing excessive cost.

In connection with the foregoing description, it may be of interest to some readers to learn that the works of Mackintosh, Hemphill & Co. were formerly known as the Fort Pitt Cannon Foundry or the Fort Pitt Foundry, which in many ways is historically famous. The Fort Pitt Foundry was established about 1810 by Joseph McClurg at the corner of Fifth Avenue and Smithfield Street, the present site of the Post Office, and was subsequently removed (1831) to its present site on Twelfth Street and the bank of the Allegheny River.

The Fort Pitt Foundry made cannon for the Lake Erie fleet under Commodore Perry and for the defence of New Orleans during the war with Great Britain, 1812-1814. In those days the cannon were bored in primitive boring mills driven by horse power, old worn-out or blind horses being generally employed for the purpose. Three or four years after, the horses were superseded by a high-pressure steam engine built by Oliver Evans. It was at these works that Lieutenant Rodman, while employed to superintend the casting of a large number of eight-inch guns, invented the famous Rodman cannon, which owed its superiority to being cooled from the interior by a stream of water circulating through the core. The first Rodman cannon was cast in 1849, and subsequently many hundreds were made, which were used in the Civil War. The largest one made had a bore of twenty inches and weighed, when finished, about fifty-eight tons. The first locomotive built west of the Allegheny Mountains was constructed at these works in 1841.

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NEW SHOPS OF THE C. R. OF N. J.

AN INTERESTING EXAMPLE OF CONCRETE CONSTRUCTION.

While the use of concrete in substitution for masonry is constantly becoming more prevalent, there has not come to our notice an example where its use is so extensive in the construction of industrial buildings as in the instance of the new car-shops which are now being built at Elizabethport, N .J., by the Central Railroad of New Jersey. With a single exception, all the buildings in this plant are being constructed with concrete walls. In the case of three buildings and a large fresh water reservoir, concrete is employed in building the roof as well as the walls and foundations. The machine shop has concrete foundations and brick walls. This is the only building of the group where the brick construction was adhered to.

Throughout the entire work a series of interesting experiments was instituted. One thing that is strikingly at variance with the ordinary practice in concrete construction, is the entire exclusion of trap rock in the mixture. In various portions of the work different mixtures are employed, but they are either of cinder, furnace slag, sand and cement, or gravel, sand and cement. For the foundation and heavy work the latter composition is employed. In some of the walls the cinder mixture is used. In every instance the mixture is approximately four to one. Work on the buildings has been in progress several months, and it is not expected that the buildings now under way will be completed prior to January 1, 1902.

Probably the most conspicuous portion of this undertaking is the large roundhouse, the walls of which are now approaching completion. This building is of the usual semi-circular construction. It is to be 400 feet in diameter. Half of the wall is now ready for the roof; the other half is about up to the windows. This building is being constructed entirely of concrete up to the roof. The roof will be of wood, with an upper surface of tar and gravel. The concrete wall is being built eight inches in thickness. Owing to the wide spaces between the windows the wall is considered sufficiently safe to stand without bracing, with the exception of the westerly section, which is to be permanently supported by means of timber bracings. In the construction of this building the foundations and wall up to the window line were first finished, being built in the ordinary manner by pouring the concrete into molds built of tongued and grooved pine boards. For the construction of that portion of the structure above the window sills special wooden frames were built. These were just the proper height to extend to roof line from the finished portion of the wall, and were of sufficient width to allow for the molding of three windows with each set of frames. The window spaces were cut out of each frame. The frames were properly supported so that two stood directly opposite each other, and they stood exactly eight inches apart. As the concrete was filled in between each pair of frames small strips were nailed along the sides of the window spaces, and thus the intervening spaces were filled in solid with the concrete mixture. The frames then remained for three or four days until the mixture hardened. Then they were removed and shifted to another portion of the wall, where the process was repeated. In this manner half a dozen sets of frames are being made to serve for the construction of the entire wall, with the exception of the west end, where a special frame with extra supports is erected.

The pits in the roundhouse are also being constructed of concrete. The cement is poured in wooden molds which rest on solid foundations of concrete. The foundations are about 12 inches thick, and rest on sheets of expanded metal, which are calculated to aid in obtaining a solid bottom. It may here be remarked that this kind is employed in connection with all foundations throughout the plant, as the grade at this point is about even with tide level and water is encountered a few feet below grade. Consequently throughout the entire work the foundations have necessarily been planned wide and flat rather than deep. In pouring the track beds long 1-inch bolts are imbedded vertically in the mixture at proper intervals, and to these the shoes holding the rails are fastened. Directly in front of the roundhouse there is a peculiar little structure which presents the appearance of a solid block of concrete 180 x 70 feet. It is of concrete—walls, roof and all. It will be used as a storage house for oils. One little sunken doorway surrounded by concrete wall is its only opening.

Looking east from the oil house the transfer table, 170 feet wide, runs in a northerly direction for 400 feet. As this is comprised entirely of a series of parallel foundations, it is constructed throughout of concrete. The pits are similar to those in the roundhouse and the same method of construction is employed.

East of the turntable the big machine, erection and boiler shop looms into view. This building is 700 feet long and 160 feet wide. As previously stated, the foundations are of concrete and the walls of brick. The structure is of steel skeleton construction. The foundation is built of a cinder-slag mixture and is 10 feet wide at the base, rising to a height of 6 feet above the grade and tapering to a width of 2 feet on top. Here commences the 12-inch brick wall. This is surmounted by a roof built of planking and tar and gravel. The foundations for the various machine tools to be installed in this building are also constructed of concrete. There is also a concrete subway running through the entire length of the building, which contains frequent manholes. In this the electric wires, pipes, etc., will be carried, and the manholes allow for entrance to any point, so as to permit inspection or adjustment of the wires at will. From this will be gathered, of course, that the machinery is to be operated electrically.

In back of the machine shop the forge shop is being erected. This building will be 175 x 300 feet and will be built of concrete around a steel frame to the front. The roof will be of planking, tar and gravel. The walls are 8 inches thick.

The power house is the only building in the entire group in which any attempt at ornamentation was made. Plain as it is, the favorable appearance of box column effect will be readily appreciated. This is another structure entirely of concrete. Floor, walls and roof are all of the concrete composition. The foundations for the boilers and the engine bed are also built of concrete. The building is 175 x 22 feet and attains a height of 25 feet. Alongside of the powerhouse there is a storage reservoir for retaining rain water drained from buildings.—*The Contractor and Real Estate Record.*

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A Chinese proverb truly says that he who labors with his strength shall be governed by others, but he who labors with his mind shall govern others.

NEW REMONTOIR CLOCK.

A CLOCK MECHANISM HAVING NEW FEATURES OF INTEREST TO THE DESIGNERS OF FINE MACHINERY.

Fig. 1. Exterior of Clock.

This design is by James Arthur, President of the Arthur Company Machine Works, 188 and 190 Front Street, New York, where seven of these clocks have been built, exclusively for presentation purposes, and where one may be seen running.

The complete clock is shown in Fig. 1. It stands nearly seven feet high and the top is finished with a Doric Stylobate to form a base for a piece of art work. Both the front doors are hinged, and as they are full width they give very free access, but in addition to this the head lifts off, leaving the movement standing clear all around. A mirror covers the whole back so that the movement may be seen from all sides. This, and the fact that the movement is skeleton work, makes it a fine example of exposed mechanism. The case is quartered oak, piano finished inside and outside. The design of the case is very severe and solid, its bold simple Grecian moldings making it very harmonious with the elaborate heavy movement. It would be difficult to imagine a piece of work in which flimsy ornament is so completely wanting and yet the effect of the whole is very striking.

The meaning of the term "Remontoir" may not be familiar to all. Strictly it means to remount, or to rewind. In this clock the main weight does not drive the seconds hand through the usual train of gears. Its office is to lift a frame once a minute, which serves as an auxiliary weight and which carries a wheel gearing directly with a pinion on the axle of the seconds hand. Once a minute, therefore, the clock is rewound by the lifting of this frame; and a much more uniform action is given the escapement than if the scape wheel were driven through a long train of gears in which the irregularities due to friction would affect the time-keeping qualities, particularly if the movement needed cleaning.

The following description of the works of the clock was furnished by Mr. Arthur:

Movement.

The general design is shown in elementary lines, Fig. 2. Wheels and pinions are shown by their pitch circles and number of teeth marked on each. The 12-hour, 1-hour and 1-minute axles are on the corners of an equilateral triangle of six-inch sides and are extended through the front frame, carrying the hands by friction; so they can be easily set, or taken off by the fingers. The clock has, therefore, no "cluster" or "face-plate wheels" as is usual in an ordinary movement.

Commencing with the great wheel *A*, revolving once in 12 hours, and calculating the train of gears connecting it with the hour hand at the right, we have,

$$\frac{144 \times 80}{40 \times 24} = 12,$$

which gives the 1-hour wheel *B*. Next, taking the train extending from the hour hand to the fly *L*, we have,

$$\frac{120 \times 120}{24 \times 10} = 60;$$

that is, the fly must make one turn per minute. The pinion *C* of this train is also used as an intermediate between gears *B* and *D*, thus making an hour wheel of *D*. The wheel *D* is mounted loose on a stud projecting inward from the back frame and is therefore only an intermediate, or stud wheel, as it has no axle. From this 1-hour wheel *D*, towards the escapement we get,

$$\frac{120 \times 120}{16 \times 15} = 60$$

revolutions per hour, giving the 1-minute wheel *E*, which is on the same spindle with the 15-tooth pinion at the upper apex of the triangle. Now, note that the revolutions of the fly *L* and the scape wheel *E* are equal, being one per minute. If we stopped here we would have only an ordinary clock train, much more elaborate than usual, but still only a running train. The meaning of these extra wheels will become plain as we proceed to the remontoir movement. Anyone interested can easily draw this movement actual size by laying down a 6-inch equilateral triangle and drawing all the gears 24 diametral pitch, making the scape wheel 4 inches, and the axle of the anchor and pallets 4 inches above scape wheel axle. Dials are 6 inches diameter and touch each other.

Remontoir.

Remember that wheel *D* rides on a stud in the back frame. Into this stud the end of the scape wheel axle is pivoted at its rear end. A similar stud is fastened in the front frame and through it passes the front end of the same axle, carrying the seconds hand. This leaves the scape wheel axle running in fixed bearings and free from disturbance. *F G* represents the sides of a complete rectangular frame swinging on the two studs above mentioned. These studs project inward and frame *F G* is of such a width that it just swings easily inside the clock frames. In this frame, wheel *H* and pinion 16 are mounted on the same axle and pivoted. Bracket *I* is part of this frame and against this bracket rests the wiper, or arm *J*, which is on the axle of the fly. This evidently stops the whole train of the clock from wheel *D* down to the great wheel *A*. But what would we expect to happen with the wheels *E H* and their pinions?

The end of the frame to the left is made heavier by wheel *H*, with its pinion, and pinion 16 ought to roll *down* on the

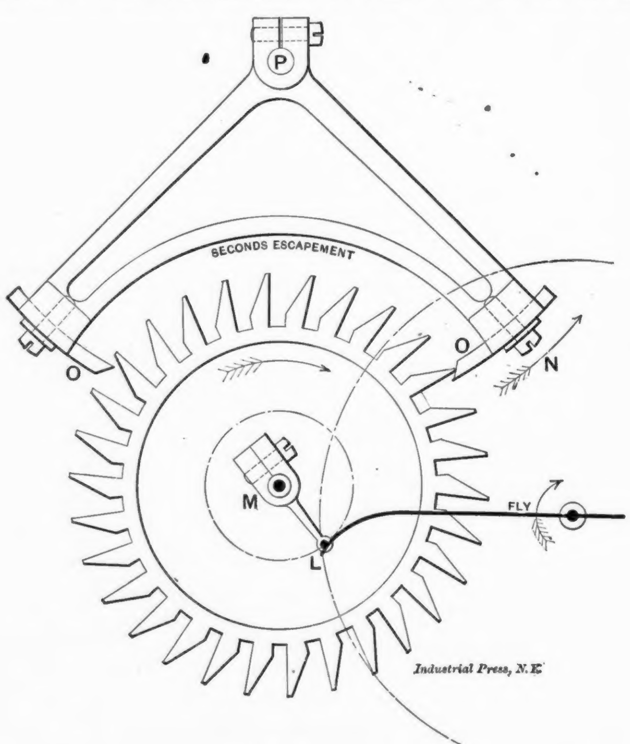


Fig. 2. Escapement.

wheel *D* (now standing still). That is, the end of the frame *F*, with wheel *H*, and pinion 16, will *sink downwards*, driving the scape wheel as per arrow for one minute, or one revolution. At the end of this minute the end *G* of the frame has *risen* till the wiper *J* passes the lower end of bracket *I*, and the fly makes one turn; which means that the train with

the hour and minute hands moves forward one minute. This motion lifts the end *F* and brings end *G* *down* again to the position shown in the drawing. The motion of 1 minute advances the wheel *D* one-sixtieth of a revolution, and by this motion wheel *H* and pinion 16 are lifted to roll *down* again for another minute. In a certain sense wheel *H* is always rolling *down*, even during the time it is being lifted; in other words *H* is continuously driving scape wheel *E*. A small balanced crank M, which is adjustable, will be seen on scape wheel axle. The tip of one wing of the fly *L* drops on this little crank pin about the 57th second of the minute and is liberated in the middle of the 60th second, letting off the remontoir movement so that the second and minute hands register at the same instant of time on the division marks of their respective dials. In the elementary explanation of letting off the remontoir, this crank was left out for the sake of simplicity. To make the matter positively plain let us suppose that in Fig. 3 the remontoir has just been let off, the wiper *J* striking the spring on *I*, which acts as a cushion to quench the blow. This blow is quite light, as the office of the fly is to produce an easy, uniform motion. Still further, this moderate motion enables us to see the one minute advances of the hands; for without the fly the motion would be too quick and jerky. As the end *G* of the frame rises, *J* passes the spring and rests on the lower end of bracket *I*, which it passes about the 57th second, at which point in the motion the tip *L* of the fly is held by crank pin of *M* till liberated in the middle of the 60th second. This crank *M* is not necessary to the correct running of the clock, but is a refinement, and can be set to let off the remontoir movement even to the fraction of a second.

The working out of all details in this design can be traced in the general views, Figs. 5 and 6. Dials are graduated on a dividing engine, the figures only being engraved, and the finish is dull, or "frosted," silver. This accuracy of graduation taken along the high numbered train of finely-cut wheels gives an unusual precision in the registration of the hands on the dial marks.

The frame work is so constructed that all the delicate parts of the movement, pallets with their axle and crutch, remontoir frame, wheel *H* and axle, wheel *D*, scape wheel, and fly can all be taken out without taking it apart. This leaves only the large heavy parts of the movement pivoted directly in the frame. This is no small matter, for all parts requiring delicate adjustment can be attended to without even taking the main frame from the clock case.

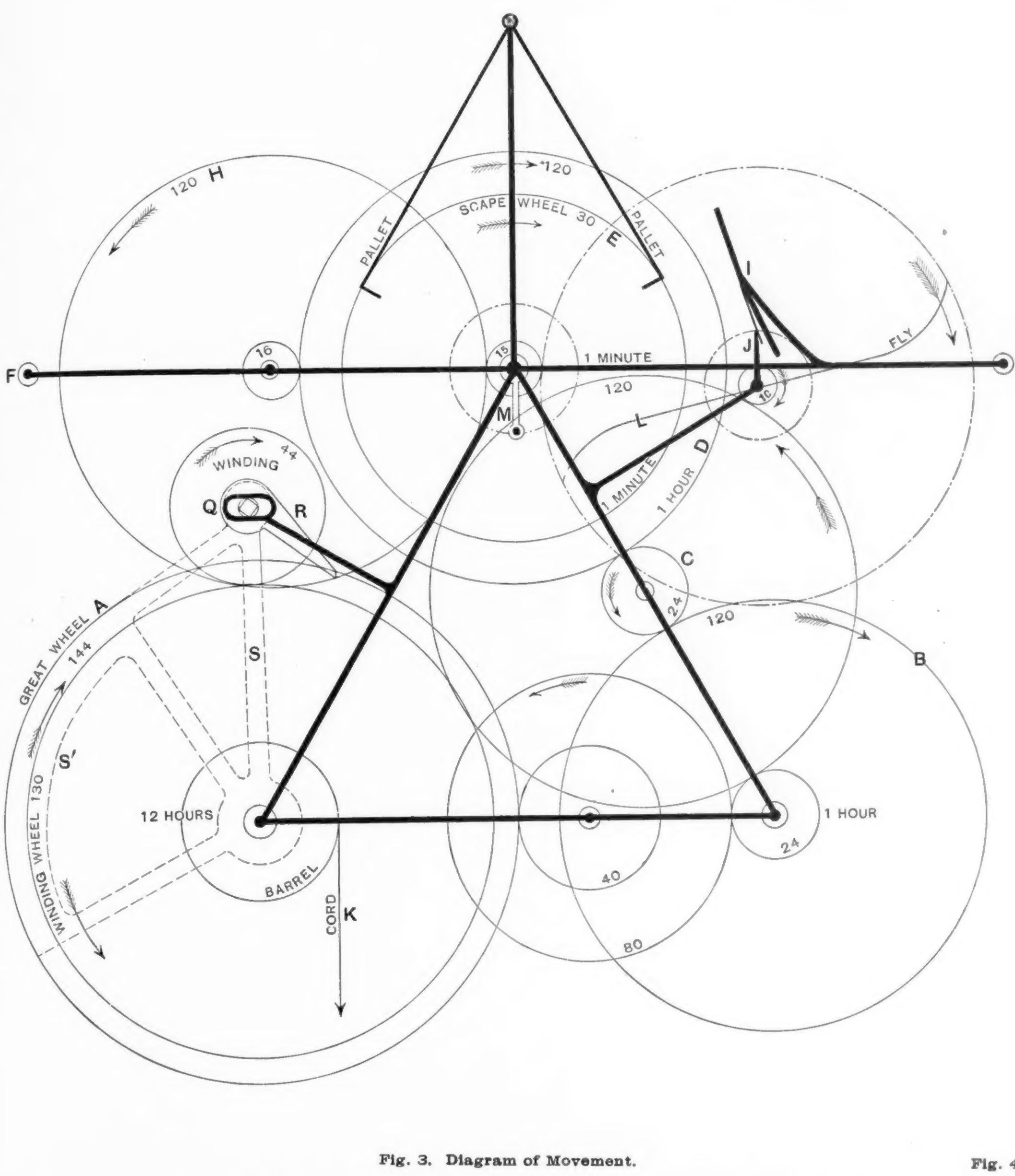
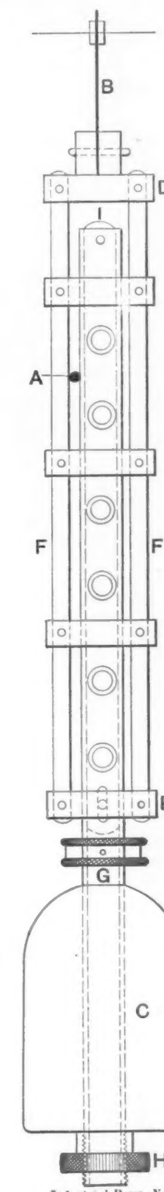


Fig. 3. Diagram of Movement.



Industrial Press, N.Y.

Fig. 4. Compensating Pendulum.

Escapement.

In Fig. 2 (arms of wheel not drawn) the escapement is shown so that little explanation is necessary. It is the "Graham" or dead-beat type, the pallets *O O* being portions of a circle around center *P*. These pallets are clamped in grooves, two screws in each, so they slide under the clamps for setting. These and the clamp hub at *P* enable all adjustments to be made without beat screws in the crutch. The crutch is simply a steel wire bent at the lower end to go between the bars of the pendulum at *A*, Fig. 4, and is somewhat elastic, so as to avoid injury to scape wheel if pendulum

is swung too far at any time in starting the clock. The "dead" surfaces O O are always correct and cannot be changed by the other adjustments. Further, these inserted pallets have another advantage, as they can be made flint-hard and polished to any degree of accuracy and fineness as separate pieces.

Pendulum.

In Fig. 4 (shortened in drawing) B is the usual spring, in this case ½ incn wide and 9-1000 inch thick. The cross-heads D and E are riveted fast to side rods F F, which are about 32 inches long. The three cross-heads in center may

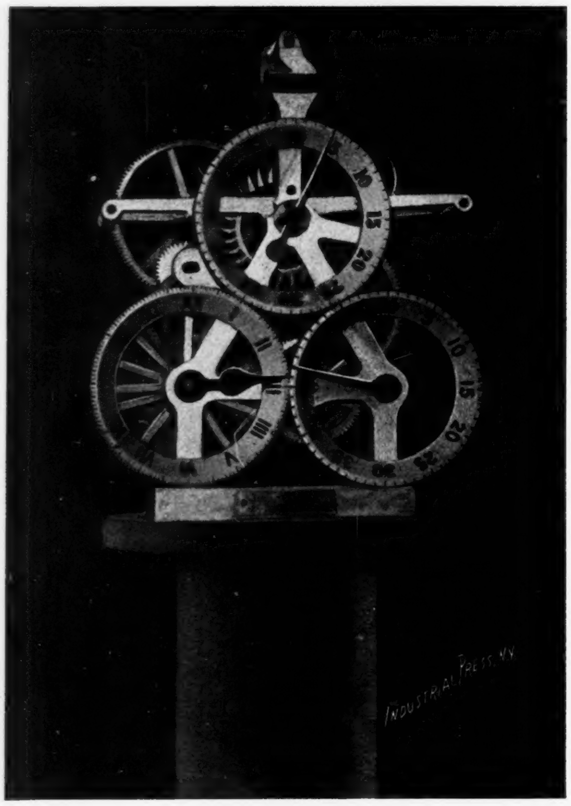


Fig. 5. Front View of Movement.

be neglected as they are simply guides to keep the rods parallel. The bob C is 8 inches long and slides on the steel tube G, and is adjusted by a fine thread nut H. The milled collar at G is pinned fast to the steel tube, and by holding it by one hand very fine adjustment of nut H may be made with the other. Inside the tube is an aluminum rod I reaching just below the cross-head E. Tube and rod are pinned fast at I, but the aluminum rod *only* is pinned fast to cross-head E. The tube is slotted where the pin of cross-head E passes through it, as shown in dotted lines. Now, note the result of this. The cross-head E is *suspended* from D by rods F F, and from this same cross-head E is *projected upwards* an aluminum rod to I, just like a column. It acts as a column, for the bob is suspended from its top end I by the steel tube G, which passes freely through cross-head E.

As aluminum expands by heat more than twice as much as soft steel this column will expand more than enough *upwards* to compensate the expansion *downwards* for the tube and side rods together. This excess is needed to correct the spring B, and also a little at the lower end of the pendulum, since the brass bob *upwards* is not quite enough to compensate the portion of the steel tube between G and H *downwards*, because brass has *less* than half the rate of steel.

The result of this is that the center of oscillation will be approximately free from change; or, in other words, that the pendulum will be constant in length so that its oscillation will be uniform and the clock will not be appreciably influenced by temperature. While *expansion* of metals only has been spoken of above, it is evident that *contraction* by sinking temperatures will act on the pendulum in the reverse order without changing its length. The six holes shown in the tube are to give circulation of air and cause all parts of the pendulum to expand and contract at the same time. It might be well to state here that this compensation for temperatures cannot be made perfect. The mercurial pendulum is of the same class; that is, it depends for compensation on the different ratios of expansion in metals, but since aluminum, with its high ratio, has become an article of commerce, a pendulum equally accurate, and much less subject to accident, can be made as above.

Finally, as the principal parts of this pendulum are about the same thickness it will respond to quick changes in a nearly uniform manner. The fact that the bob C would heat up or cool off rather *behind* the other parts is hardly worthy of notice, since the amount to be corrected here is so small as to be almost a vanishing quantity.

It is well known that a seconds pendulum is a little over 39 inches between points of oscillation and suspension; and if a silk thread is used to suspend a small lead pistol bullet this will be found correct for a short experiment. But the pendulum above described is over 43 inches from point of suspension to center of bob G. How is this? Because this is necessarily a compound pendulum on account of the weight of rods, tube and cross-heads which are nearer the point of suspension than the bob C. As all this matter tries to beat *quicker* than seconds the bob must be lowered 4 inches to correct them. In other words, at this length (43 inches) the bob tries hard to beat *slower* than seconds and thus counteracts the rods higher up; so that after all, the points of oscillation and suspension are at the correct theoretical distance, the former in this case being very near the top end of the bob at G.

Winding.

A good timekeeper must run correctly while it is being wound. In this case the great wheel A, Fig. 3, is *fast* on the 12-hour axle, while the winding wheel 130, the barrel and the

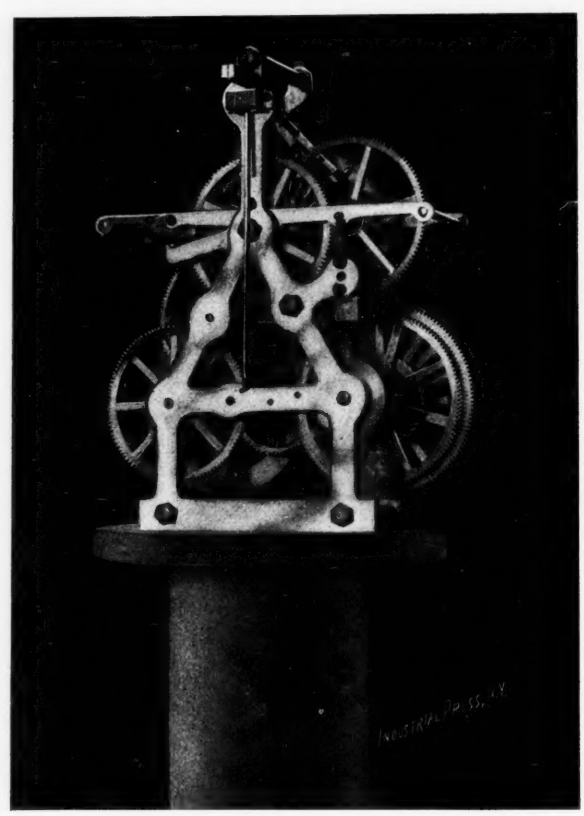


Fig 6. Rear View of Movement.

ratchet wheel are one piece and ride free on the axle. The pawl is on the great wheel. The winding pinion 44 is fast on an axle passing out in a square end to the front, as shown. It will be seen that this axle passes through the front frame in a slot at Q, giving it a motion equal to over two teeth of the great wheel. From this winding axle a pawl R lies in the teeth of the great wheel. A link S connects the 12-hour axle

to the winding axle, and this link has a sector, or heavy side S', tending to keep the axle to the left towards Q. When the clock is running this pair of winding wheels (130-44) are simply idlers. Now, put on the key and turn *right hand*, and the pawl R will push the great wheel *forward* with about the same force it was receiving from the weight and the clock is not disturbed. In other words, owing to the slot Q in the frame the pawl R must be made the fulcrum against which the winding axle presses with enough force to lift the weight. Arrows on the winding wheels show the direction *while winding*. Of course, while running with the clock they go the opposite way. Winding is supposed to be weekly, but the clock will run 8½ days, so it may be forgotten for a day.

Gearing.

Those interested, even as amateurs, are aware that clock gears differ essentially from machine gearing in the fact that the drivers act only by their faces, and that these faces act only on the radial flanks of the pinions. Driving is, therefore, all done after passing the line of centers of any pair of gears. This clock, however, is cut with regular involute cutters on a plan tested by the designer for the last five years in a large clock which has run that time, without even being cleaned. A description of that clock can be found in MACHINERY for January, 1900.

In a clock train the wheels are always the drivers and the pinions are the followers. The method of cutting the teeth is as follows: Size the wheels in the usual manner, but cut the teeth 10 per cent deeper, which will give a tooth noticeably thin. Size the pinions one-quarter diametral pitch small; that is, add only 1¾ pitch to pitch circle, and cut them regular depth. Mesh these gears seven-eighths the usual depth. Result—as teeth in both cases will be a little thin and meshing shallow the gears will work very loose, or have considerable "back-lash." Further, the pinions or followers are really a little less in pitch than their drivers, which gives action principally after passing line of centers. The looseness is necessary in clock gears to prevent dust or dirt from stopping the clock. Gears such as are used in machines would not answer in clocks for this reason. It is hardly correct to speak of back-lash in this connection, for it does not appear in clock work, as the wheels always drive slowly *one way*. This method of cutting, if not as good as the conventional "clock tooth," is certainly successful and gives results which seem beyond question. A good feature of the method is that it gives the correct center distances for any pair of wheels just as in machine work. This can be easily illustrated. Take a pair of wheels cut and mounted as in a machine. Remove them and cut the driver 10 per cent deeper; top off the follower, or pinion, one-quarter diametral pitch (= one-eighth all around) and re-cut to normal depth. Put them back in running position again and you have a pair of wheels on the correct center distance as described above. It therefore follows that center distances are correct in Fig. 3.

An interesting point in center distances may be pointed out in the case of wheel H, and its pinion 15. This distance is the *normal* for wheel D and its pinion 16, which is too wide for H, 15, apparently. This is overcome by making a calculation in proportion for H 15. This enlarges them such a small fraction that the 24 pitch cutters are still correct, especially as we are cutting a very loose fit. Pinion C being both a driver and a follower is sized normally and cut 10 per cent deep. Lower wheels of train have ¼-inch faces, diminishing upwards to ⅛ inch in H and E. All pinions are of tool steel and ⅛ inch wider than the wheels driving them. Frame work and wheels are of fine gun-metal and finished all over even to the arms of the wheels, as everything is exposed.

* * *

TWO MILES A MINUTE.

Experiments are being undertaken by the Society for Research, Germany, in the operation of electric cars at speeds of over two miles a minute. The experiments are attracting wide-spread attention, both because of the high standing of the scientists engaged upon the problem and the natural popular interest in improvements in transportation facilities. If an electric-motor car, taking its current from overhead wires and running upon an ordinary standard-gage track can carry passengers with safety at a speed of from 80 to 150 miles an hour, it is evident that the next few years will witness great changes in the means of travel between large cities.

Such enormous speeds involve questions of air resistances, weight, form and balance of vehicle, electrical transmission at high voltage and conversion to lower potential at some point between the generator and motor, and many other problems that would not occur to one unless he had investigated the subject. There were no reliable data, for example, to guide the designers in providing for the air resistance at such high speeds, and extensive experiments were conducted with large rotating fans to secure information upon this point.

The scene of the experiments with the high-speed trains is a stretch about 14¼ miles long from Marienfelde to Zossen, on the military railway line which runs southward from Berlin to the place last named. The following description of the experiments and the equipment of the road is taken from a recent report by U. S. Consul Frank H. Mason, of Berlin:

The line is of standard gage, single tracked, level, and nearly straight, there being but one slight curve—1,100 yards radius—near the southern extremity. The rails are of steel, weigh about 65 pounds to the yard, and are laid on wooden ties. During the past summer the track has been carefully surfaced, defective joints remedied and ties and ballasting put into perfect condition. Along this line have been set, at intervals of 100 feet, poles 20 feet in height, at the top of which is set in a vertical position and fastened by bolts a bow or arch of angle iron 10 feet in length, the chord of which supports the three brackets for insulators from which the three lines of conductors are hung. The conductors are ordinary copper wires about three-eighths of an inch in thickness, so hung that the trolley can make full contact from beneath.

These will carry a three-phase alternating current of 10,000 to 12,000 volts, to be generated at the works of the General Electric Company on the River Spree, about 5 miles northeast from Marienfelde, between which two points a special overhead line for transmission has been provided. One of the conditions of the problem is that this high voltage, so essential for effective transmission, shall be reduced to a safe and practicable pressure by transformers carried in the motor car itself. The measure of speed to be attempted is 124 to 136 miles, approximately, per hour, and the electrical apparatus must be sufficiently strong and heavy so that a run of 155 miles can be made at extreme speed without danger of overheating.

For this purpose two third-class passenger cars of the standard type used on the Prussian State railways have been built and turned over to Siemens & Halske and the General Electric Company of Berlin, respectively, each of whom have furnished the electrical equipments of one car according to their own ideas. There will be, therefore, two competitive machines, each representing the highest scientific skill of two leading electrical manufacturers of Germany.

The cars are about 72.18 feet in length and weigh 90.5 metric tons, of which 48 tons comprise the body and running gear (viz, two six-wheeled spindle trucks of the American type) and 42.5 tons are made up by the motors, transformers, and other details of the electric equipment. Each car is designed to accommodate fifty passengers, who, with the driver and conductor, will add about 4 tons to the aggregate weight of the carriage. The motors are four in number, aggregating 1,000 horse power, and are attached to the front and rear axles of each truck, the middle pair of wheels in each group of three running free. In the car equipped by Siemens & Halske the motors weigh 9,000 pounds, the transformers—which weigh 12 tons—are hung centrally beneath the floor, and a storage battery of 600 pounds weight supplies current for lighting purposes. The ends of the car are pointed to minimize wind resistance, and it runs, of course, in either direction. The wheels are 49 inches in diameter, and air brakes of the Westinghouse type are used. It is expected that the current will be reduced by the transformers carried under the floor of the car from the initial voltage of 10,000 or 11,000 to a potential ranging from 1,150 to 1,800 volts, which it is assumed will be sufficient to attain the proposed speed without danger to machinery or operatives.

WORKING DRAWINGS.—2.

HINTS UPON READING AND MAKING WORKING DRAWINGS-THE CONVENTIONALITIES USED.

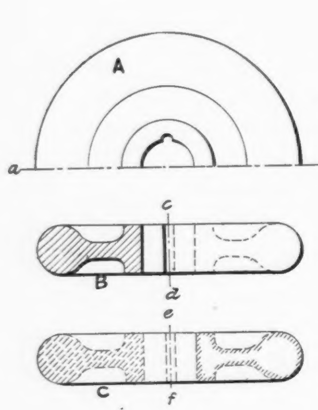
When a draftsman has to make a drawing of a machine already constructed he first measures and sketches each part separately, putting all necessary dimensions upon the sketches and then he assembles these parts, so to speak, in the form of a general drawing. On the other hand, if he has to design a machine he will first make a general drawing with the parts in place and from this he will obtain the dimensions of the various pieces which he will draw separately, or at least in sufficient detail to show clearly what is wanted. In either case he must have both a general or an assembled drawing of the machine, and detail drawings of the machine parts, the order in which they are made depending upon whether he is working from the machine itself or is originating the design.

In the general views outlines are drawn of such details as are thought essential to clearness; but as certain features of construction and many of the small parts of the mechanism would inevitably be invisible to one looking at the assembled machine, they must be represented by dotted lines if they are to be incorporated in the general view. A multiplicity of these lines leads to confusion, however, particularly if it is attempted to dimension them, and for this reason the detail sheets are necessary.

We thus see that obscure details, not visible when looking at the assembled piece, may be represented either by the use of dotted lines or by making separate views of each piece apart from its relation to the others.

Sectional Views.

A third method of representing details is by means of sectional views. Suppose, for example, a drawing were to be made of a connecting-rod end, in which were the brasses, the adjusting wedge and screws, etc. A general view of the rod might be made, with part or all of the details shown by dotted lines; and then, on another sheet, or on another part of the same sheet, the details could be drawn separately and properly dimensioned. That would be one way to make the drawings. Another way would be to make a general view of the rod as before, but to show the end as though it had been cut or sliced in a plane parallel with the paper, and the upper parts removed, exposing the details. The parts cut through would be "cross-hatched," bringing them into bold contrast, and the dimensions could all be placed on this one drawing. Such a method is possible with a simple construction having but few parts and is often adopted to advantage.



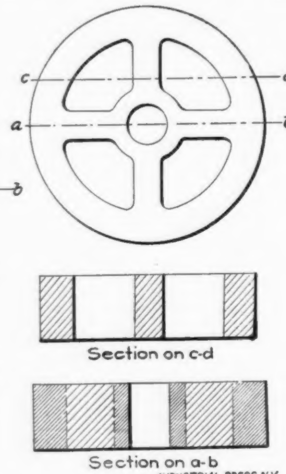


Fig. 12. Fig. 13.

Method of showing Sections.

Sectional views may also be used for much simpler purposes than above outlined. They may be used to show the shape of the arm of a pulley or of any part of any casting that can be conveniently represented in this way. The cutting plane may be assumed to lie at any angle necessary to bring out the details most clearly; or, if desired, a sectional view may represent a casting as though it were cut through a part of the distance on one plane, and the rest of the way on another plane, either higher or lower, as convenient. All that is necessary to have the view clearly understood is to draw a line through one of the views of the piece, indicating just where the sectional view is supposed to be taken, and then to make a note on the drawing to that effect.

In Fig. 12 at *A* is a plan view of a hand wheel. As the wheel is symmetrical it is quite unnecessary to draw more than half the wheel, although the whole wheel may be drawn if desired. It is here represented as though cut in two along its diameter on the line *a b*. This line should be a dash-and-dot line, as shown, and not a solid line. It was pointed out in the last number that one of the uses of a dash-and-dot line is as a center line where a piece is symmetrical, and its use here would indicate that the half of the wheel not drawn was like the part that was drawn, even if it were not otherwise apparent; for under no other condition would the figure be symmetrical.

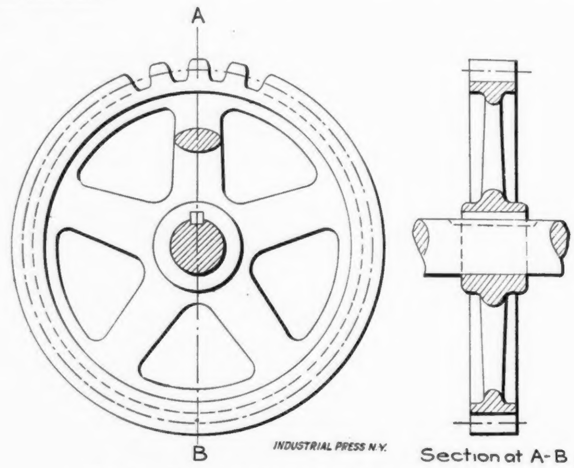


Fig. 14. Conventional Section of Gear Wheels.

At *B* and *C* in Fig. 12 are shown sectional and edge views of the hand wheel and the different ways in which they may be represented, according to the fancy of the draftsman. In *B*, to the right of the center line *c d*, is an edge view of the wheel in which the shapes of the rim and hub are shown by dotted lines, since they would not be visible to an observer who held the wheel so that he looked directly at the edge or rim. To the left of *c d* is a sectional view taken along the line *a b* in *A*.

In the view below this at *C* are shown two methods of drawing what are termed "dotted sections." The sections are supposed to be taken on the line *a b* as before, but cross-sectioning is done by dotted lines, indicating that the shape of the section would be as shown but that the parts in front of it have not actually been cut away. This is a very convenient convention to adopt at times. For example, in showing a milling-machine knee and saddle it would enable one to represent the knee and saddle as they actually appeared, and also to show a sectional view of the mechanism under the saddle and inside the knee. If, on the other hand, the view were drawn as though the knee were actually cut through one would not form an idea of its exterior appearance unless another view were drawn. It will be noted in the figure that the dotted lines extend clear across the section, as drawn at the left of *e f* and only along the edge of the section at the right of *e f*.

In Fig. 13 is a pump valve-seat having four webs connecting the outer rim with the hub. There are two ways of showing a sectional view of a piece in which webs occur. If the view were taken along the center line *a b* and sectioned, as usual, nothing would be gained, since it would give no idea of the shape of the webs. Some, therefore, prefer to take the section to one side of the web, as on the line *c d*, and as shown in the upper sectional view. This indicates clearly what the shape of the web is. Others, however, prefer to adopt the expedient illustrated in the lower sectional view. Here the section is supposed to be taken along the line *a b*, but where the plane cuts through the webs the sectioning or hatching is done with the lines further apart than in the balance of the plane, thus making enough distinction to show what part of the plane passes through the webs and what part does not. Both methods have their uses under suitable conditions.

In Fig. 14 are views of a gear wheel. The one at the left side is a side view and as all the teeth are of course alike it is unnecessary to draw more than a few of them. The pitch line of the teeth is represented by a dash-and-dot line, this convention always being followed. In the part of the rim where the teeth are not drawn, the face of the gear is indicated by a solid line and the position of the roots of the teeth by a dotted line. Others may prefer to adopt some other convention. To show the shape to which the arms are to be formed, a sectional view of one of the arms is drawn in this view. The end of the shaft is supposed to be broken off and is sectioned.

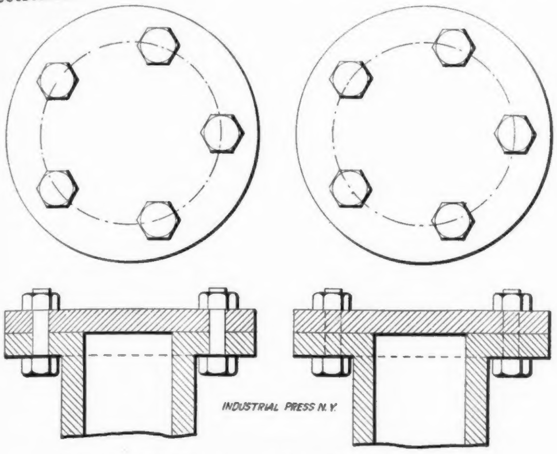
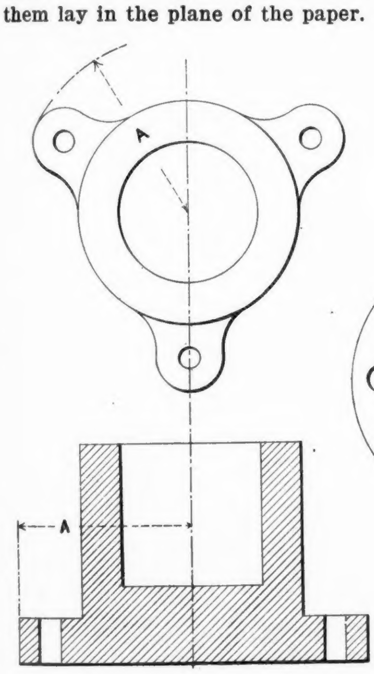


Fig. 15. The Representation of Bolts in Sections.

The right-hand view in Fig. 14 is a sectional view taken along the line *A B*. It will be noted that the shaft and key are not sectioned. The method followed in such cases is usually to section the castings or enclosing parts, such, for example, as the hubs, rims, etc., of a wheel, but not enclosed parts like shafts, rods, bolts, keys, etc. A bushing being both an enclosed and enclosing part might or might not be sectioned, individual judgment dictating the method here as elsewhere. This gear has five arms and the line *A B* cuts through one of them only. They are not sectioned in the right-hand view and two opposite arms are drawn as though both of them lay in the plane of the paper. While this is not correct, it is the method usually followed. The method of representing the gear teeth in sectional views is generally as shown in this sketch.



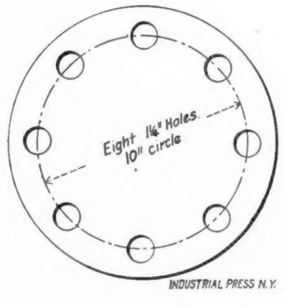


Fig. 16. Section of Unsymmetrical Object. Fig. 17. Dimensions of Holes in a Circle.

In Fig. 15 are sectional and top views of a cylinder or pipe on which a blank flange is bolted. There are five bolts and the plane in which the sections are taken would cut through only one of them. Most draftsmen, however, would draw the sectional view, as indicated at the left. Two bolts are shown, as though both were in the plane of the section, and these bolts are not sectioned, but are drawn in full, as explained above. It is not necessary, moreover, to show more than two of the bolts, since it would detract from the clearness, and the top view shows plainly how many bolts there are. Some draftsmen think bolts drawn in this way are too prominent and prefer to represent them in sectional views, as shown at the right in Fig. 15. This method also has the sanction of good usage.

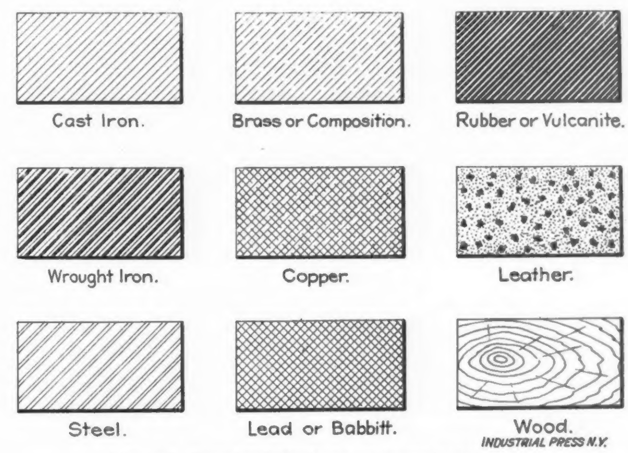


Fig. 18. Standard Methods of Cross-hatching.

Fig. 16 is another example of a figure that is not symmetrical in all respects. It shows two views of a step bearing having three ears or lugs for bolting it to its base plate. In making a sectional view of such a piece should the cutting plane be supposed to pass through the lugs? In most cases, yes, and according to common practice the sectional view would be made symmetrical, and the distance *A* in the lower view, from the center of the piece to the outer end of each lug would be made equal to the distance *A* in the upper view.

In any machine various kinds of metal and other material are used, and when sectional views are made it is convenient to have some standard method of cross-hatching the different parts to indicate what the metal or material is. Conventional sectionings adopted for this purpose are given in Fig. 18, the system there represented following very closely that used by the U. S. Navy Department. It should be said, however, that draftsmen are coming more and more to section all parts alike, adopting the style used for cast iron for all kinds of material and then to print on the pieces themselves what the material is of which they are composed. This avoids the possibility of mistake through failure to understand what the conventional methods of sectioning are supposed to represent.

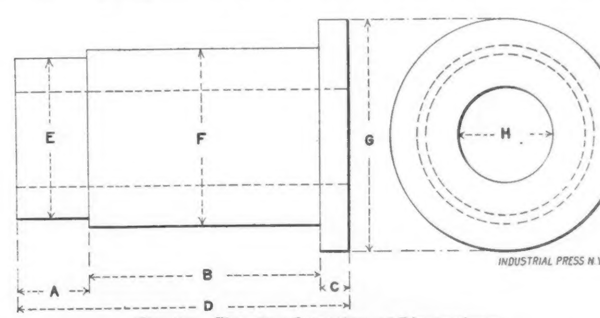


Fig. 19. Showing Location of Dimensions.

Dimensions.

The most important part of a drawing is the dimensions. They should be given so fully and completely that a workman will never have occasion to measure a drawing. The dimensions should include an "over all" measurement and the different measurements that make up the "over all" size. Dimension lines and the extension lines which the arrow heads of the dimension lines touch are usually fine black lines made up of long dashes. They should be so drawn as to appear secondary in importance to the drawing itself. Some draftsmen draw all these lines in red ink and use a solid instead of a broken line. In a blue print the red lines will appear lighter than the black ones, making a good distinction.

In Fig. 19 is a sketch of a bushing. The diameter of the

bore is given at *H* by a dimension line passing through the center of the circle. It is somewhat confusing, however, to have more than one dimension line passing through a center and so it is better to have the other diameters given elsewhere, if possible, as at *E*, *F* and *G*. The length of the various steps of the bushing are given at *A*, *B* and *C*, and it will be noticed that they are slightly offset—that is, the dimension lines do not extend in one straight line. This makes a very clear arrangement. The over-all dimension is at *D*. Methods of placing dimensions on holes that are drilled in a circle or in a row are shown in Figs. 17 and 20. That in Fig. 17 requires no explanation. In Fig. 20 center lines are drawn in each direction through the centers of the holes and the dimensions are given from center to center each way, and also from the edges by which the holes are to be located.

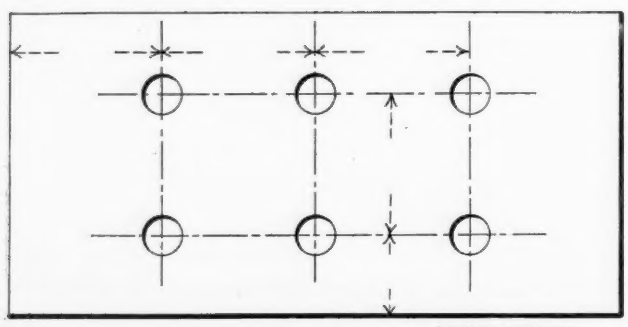


Fig. 20. Dimensions of Holes in Straight Lines.

Fig. 21 refers mainly to the dimensions of bolts. At *A* is a Hex. bolt, so drawn that three sides of the head are visible. Bolts are usually drawn in this way because they look well, and as most bolts used in machinery are standard and taken from stock no dimensions are necessary other than to specify the diameters and lengths. These may be printed on the drawing, or better yet on a list of bolts and other small parts, sometimes called an order list, which should accompany the drawings. Every bolt and machine screw should be specified in some such way. At *B* is a Hex. bolt, so drawn that only two sides are visible. If it is a special bolt it should be represented like this so that the dimension across flats can be given, to which the head is to be milled. At *C* and *D* are two ways of drawing a square bolt, according to whether the dimension across flats is necessary or not. In cases like *B* and *D* the abbreviations Hex. and Sq. should be used as shown, so there will be no mistake about the style of head desired.

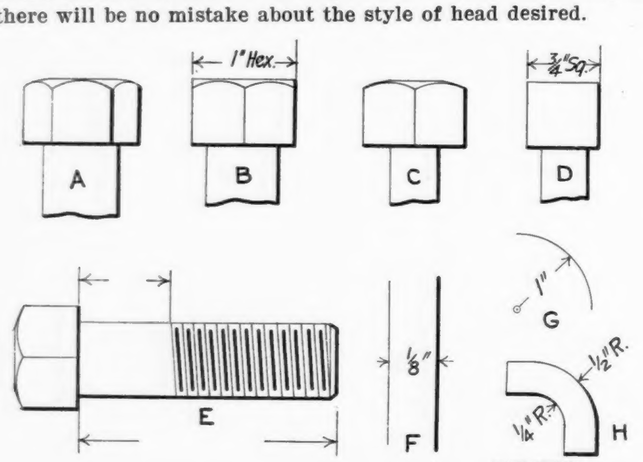


Fig. 21. Dimensions of Minor Details.

The length of a bolt should be given from under the head, as at *E* in Fig. 21. The total length should be given and also the length from the head to the top of the thread, which shows how high up the thread is to be cut.

At *F* in Fig. 21 is shown how to give a dimension when the space is narrow and at *G* and *H* how radii may be denoted.

There are various rules about the dimension figures themselves, to which allusion should be made. First of all, the figures should be plain, that no mistake can be made in regard to feet and inches. The usual practice is to represent feet by the prime mark (′) and inches by the double prime mark (″). Some hold that this is not distinction enough and insist on the use of ft. for feet, while retaining the inch mark. Some also object to the slanting line between the numerator and denominator of fractions, holding that the line might be mistaken for a figure one, if carelessly made. Some prefer the horizontal line and others write the numerator over the denominator and omit the separating line entirely. It is customary to arrange all the dimensions to read either from the bottom or the right-hand side of the drawing, though it is possible to have everything read from the bottom by making the figures upright, or up and down on the sheet, regardless of the direction of the dimension lines. In the shop inches are used more than feet in measuring, and dimensions are usually in inches, except for large work. In some shops they are given in inches even up to 10 feet.

Finish.

A drawing is or should be so marked as to tell the workman what surfaces are to be finished and what kind of finish is desired. This is often done by writing a character, resembling a letter f, across the line representing the edge of the surface to be finished, as in Fig. 22. Another way is to write the words "polish," "finish," "ream," etc., near the edges of the surfaces to receive the treatment indicated. Still another method that is much in use is to draw a red line near the edge of each surface to be finished. When a blueprint is taken from such a tracing the red lines will print fainter than the black lines, and a draftsman can easily trace over them on the blueprints in red ink. Still another method that can be used to advantage in a manufacturing plant is to put only the dimensions of finished surfaces on the drawing, leaving off entirely all dimensions of rough surfaces that are of service to the patternmaker but to no one else. The work-

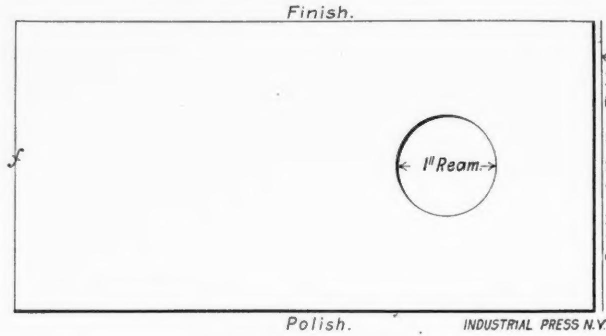


Fig. 22. Indicating Finish.

man in the shop then knows that wherever he sees a dimension the surfaces are to be machined. One feature that should be looked after more carefully than is usually done is to indicate how closely the various parts must be finished to size. If a piece must be made within a half-thousandth of an inch the workman ought to know it, and if a thirty-second of an inch is near enough he surely ought to know it. The practice of giving dimensions in thousandths of an inch where needed and of using plus and minus limits where sizes are to be kept within limits, putting the limits on the drawing, is a good one to follow.

* * *

STANDARDIZATION OF EXTRA HEAVY FLANGES.

Steam pressures varying from 100 to 250 pounds pressure entered into engineering practice about the year 1889. For pressures less than 100 pounds there had long existed confusion regarding standards for flanges of pipe, fittings and valves. A schedule of standard flanges was adopted July 18, 1894, by a committee of the Master Steam and Hot Water Fitters' Association, a committee of the American Society of Mechanical Engineers, and the representatives of the leading valve and fitting manufacturers of the United States. As the use of high steam pressures became more general there came into existence so many different diameters, thicknesses, drilling circles and number of bolts for flanges on fittings, valves and pipe for extra heavy pressures that manufacturers could not safely keep stocks of goods, and mill architects and engineers were greatly delayed at times in making up specifications for contemplated work, on account of time taken to find out what the different manufacturers could or would furnish.

Recognizing the need of a standard for extra heavy flanges,

Mr. J. C. Meloon, mechanical superintendent of the General Fire Extinguisher Co., Providence, R. I., issued an invitation to the leading valve and fittings concerns of the country to meet and consider this subject. In response to this invitation several of the largest concerns sent representatives to a meeting at New York, April 24, 1901, and at that meeting a committee was chosen to formulate a standard. This committee consisted of J. C. Meloon, mechanical superintendent of the General Fire Extinguisher Co., Providence, R. I.; J. F. O'Brien, secretary of the Pratt & Cady Co., Hartford, Conn.; L. R. Greene, engineer of the Walworth Mfg. Co., Boston, Mass.; H. D. Gordon, M.E., of Jenkins Bros., New York, N. Y.; F. A. Strong, superintendent of the Eaton, Cole & Burnham Co., Bridgeport, Conn.; and F. N. Connet, engineer at Builders' Iron Foundry, Providence, R. I.

Mr. Meloon was made chairman, Mr. O'Brien, secretary. The committee had various sessions and submitted to the manufacturers interested the following recommendations and schedule for standard at a meeting held in New York City, June 28, 1901:

Paragraph No. 1.—Multiples of four for drilling.

Paragraph No. 2.—Drilling should straddle vertical axis.

Paragraph No. 3.—Bolt centers not to exceed $3\frac{5}{8}$ inches except on $2\frac{1}{2}$ inches size. The committee at first proposed 8 $\frac{5}{8}$-inch bolts, but sample elbows and flanges were drilled and bolted together, and it was found that 8 $\frac{5}{8}$-inch bolts interfered with inserting bolts.

Paragraph No. 4.—Distance from center of bolt to edge of flange should always equal or exceed the diameter of bolt plus $\frac{1}{8}$ inch for 9-inch valves and under, and diameter of bolt plus not less than $\frac{1}{4}$ inch for sizes larger.

Paragraph No. 5.—

Size of Pipe.	Diameter of Flange.	Thickness of Flange.	Diameter of Bolt Circle.	Number of Bolts.	Size of Bolts.
Inches.	Inches.	Inches.	Inches.		Inches.
2	$6\frac{1}{2}$	$\frac{7}{8}$	5	4	$\frac{5}{8}$
$2\frac{1}{2}$	$7\frac{1}{2}$	1	$5\frac{7}{8}$	4	$\frac{3}{4}$
3	$8\frac{1}{4}$	$1\frac{1}{8}$	$6\frac{5}{8}$	8	$\frac{5}{8}$
$3\frac{1}{2}$	9	$1\frac{3}{16}$	$7\frac{1}{4}$	8	$\frac{5}{8}$
4	10	$1\frac{1}{4}$	$7\frac{7}{8}$	8	$\frac{3}{4}$
$4\frac{1}{2}$	$10\frac{1}{2}$	$1\frac{5}{16}$	$8\frac{1}{2}$	8	$\frac{3}{4}$
5	11	$1\frac{3}{8}$	$9\frac{1}{4}$	8	$\frac{3}{4}$
6	$12\frac{1}{2}$	$1\frac{7}{16}$	$10\frac{5}{8}$	12	$\frac{3}{4}$
7	14	$1\frac{1}{2}$	$11\frac{7}{8}$	12	$\frac{7}{8}$
8	15	$1\frac{5}{8}$	13	12	$\frac{7}{8}$
9	16	$1\frac{3}{4}$	14	12	$\frac{7}{8}$
10	$17\frac{1}{2}$	$1\frac{7}{8}$	$15\frac{1}{4}$	16	$\frac{7}{8}$
12	20	2	$17\frac{4}{4}$	16	$\frac{7}{8}$
14	$22\frac{1}{2}$	$2\frac{1}{8}$	20	20	$\frac{7}{8}$
15	$23\frac{1}{2}$	$2\frac{3}{16}$	21	20	1
16	25	$2\frac{1}{4}$	$22\frac{1}{2}$	20	1
18	27	$2\frac{3}{8}$	$24\frac{1}{2}$	24	1
20	$29\frac{1}{2}$	$2\frac{1}{2}$	$26\frac{3}{4}$	24	$1\frac{1}{8}$
22	$31\frac{1}{2}$	$2\frac{5}{8}$	$28\frac{3}{4}$	28	$1\frac{1}{8}$
24	34	$2\frac{3}{4}$	$31\frac{1}{4}$	28	$1\frac{1}{8}$

Paragraph No. 6.—The bolt circle diameters, as above stated, will allow the use of calking recess on pipe flanges, provided such device is specified.

The schedule presented was unanimously adopted by the manufacturers present, and January 1, 1902, was the date set for the adoption of same. The following firms have agreed to adopt the standard and put same into effect January 1, 1902:

The Eaton, Cole & Burnham Co., Bridgeport, Conn.; the Chapman Valve Mfg. Co., Indian Orchard, Mass.; the Walworth Mfg. Co., Boston, Mass.; the Crane Co., Chicago, Ill.; the Pratt & Cady Co., Hartford, Conn; Jenkins Bros., New York City; the General Fire Extinguisher Co., Providence, R. I.; the Builders' Iron Foundry, Providence, R. I.; the Jarecki Mfg. Co., Erie, Penn.; the Crosby Steam Gage & Valve Co., Boston, Mass.; the Kennedy Valve Mfg. Co., New York City; the Ludlow Valve Mfg. Co., Troy, N. Y.; the Lunkenheimer Co., Cincinnati, O.; the Michigan Brass & Iron Works, Detroit, Mich.; the Kelly & Jones Co., New York City; the Eastwood Wire Mfg. Co., Belleville, N. J.; the National Tube Co., Pittsburg, Pa.; the Coffin Valve Co., Boston, Mass.; the Rensselaer Mfg. Co., Troy, N. Y.; the Mason Regulator Co., Boston, Mass.; McNab & Harlin Mfg. Co., New York City; the John Davis Co., Chicago, Ill.; the Watson & McDaniel Co., Philadelphia, Pa.; the Ross Valve Co., Troy, N. Y.; and Edward P. Bates, Syracuse, N. Y.

The following firms will furnish to standard if desired by their customers:

The Best Mfg. Co., Pittsburg, Pa.; the Pittsburg Valve, Foundry and Construction Co., Pittsburg, Pa.; and the Eddy Valve Co., Waterford, N. Y.

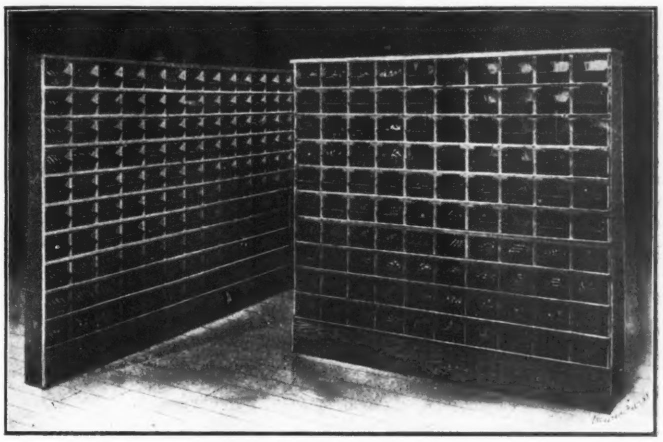
The committee's labors were very much lightened by the hearty co-operation of all the firms with whom they held communication, and the list of firms mentioned, embracing the largest manufacturers of valves and fittings in the East and West, shows the interest taken in the subject.

A limited number of the schedules will be printed by the committee, and copies can be obtained of the secretary, J. F. O'Brien, P. O. Drawer No. 66, Station A, Hartford, Conn.

* * *

A MACHINE SHOP "BAKERY."

The illustration herewith is from a photograph of two sets of shelves in the stock-room of the Fellows Gear Shaper Co., Springfield, Vt. The shelves are divided into pigeon holes, and in these are set sheet-iron pans similar to, and which we believe are in fact, ordinary baking dishes. From the use of these pans the stock-room has come to be familiarly known as the "bakery." The pans contain the small machine parts, such as bolts, nuts, pins, rolls, studs, screws, etc., and are inclined so that their contents are easily visible to one standing in front. Being of metal they are durable, can be kept clean and can be removed from their places for emptying or filling, which feature saves a great deal of time in taking care of the stock. Perhaps the best feature of the system, however, is that it is entirely flexible, having advantages over the usual arrangement in this respect that a card index system has over records kept in books. When a certain number of pans allotted to a certain class of machine parts become full and are not sufficient to contain the quantity of stock that it is desired to carry, the pans can be rearranged or moved along, making room for more in the crowded section. It is thus possible to group similar pieces together and this can be done, no matter to what extent it is found necessary to enlarge the stock room.



Stock Bins containing Pans in which Small Parts are Kept.

* * *

In the October issue of the *Cosmopolitan*, John Mitchell draws a pathetic picture of the hopelessness of the average anthracite coal miner's lot. Commencing work at a tender age, perhaps not more than ten or twelve, he first works in the dust and grime of the breaker picking slate. From the breaker he is promoted to a position as door-boy in the mine, and as he grows older and stronger to that of laborer. The next step upward is to the place of miner's helper, and from thence to that of a full-fledged miner. At this occupation he works through the prime of life, if not maimed or killed by a fall of rock, and then as advancing age robs him of strength and vigor the descent on the scale begins. He is again in turn miner's helper, laborer, door-boy, and finally a slate-picker on the breaker with the young boys, in the same position as when starting in early life, and again receiving the pay of a few cents per day.

A SPECIAL MILLING MACHINE.

DESIGNED FOR MILLING THREADS OF COARSE PITCH.

FRED J. BRYON.

The special milling machine described in the following article was designed and constructed by Mr. D. Doncaster, of the firm of Myers & Doncaster, Brooklyn, N. Y., for milling long screws of coarse pitch. It is a distinctly new departure in milling machines, and the principle of the machine can be used, with slight modifications, for milling threads of screws having other pitches and diameters.

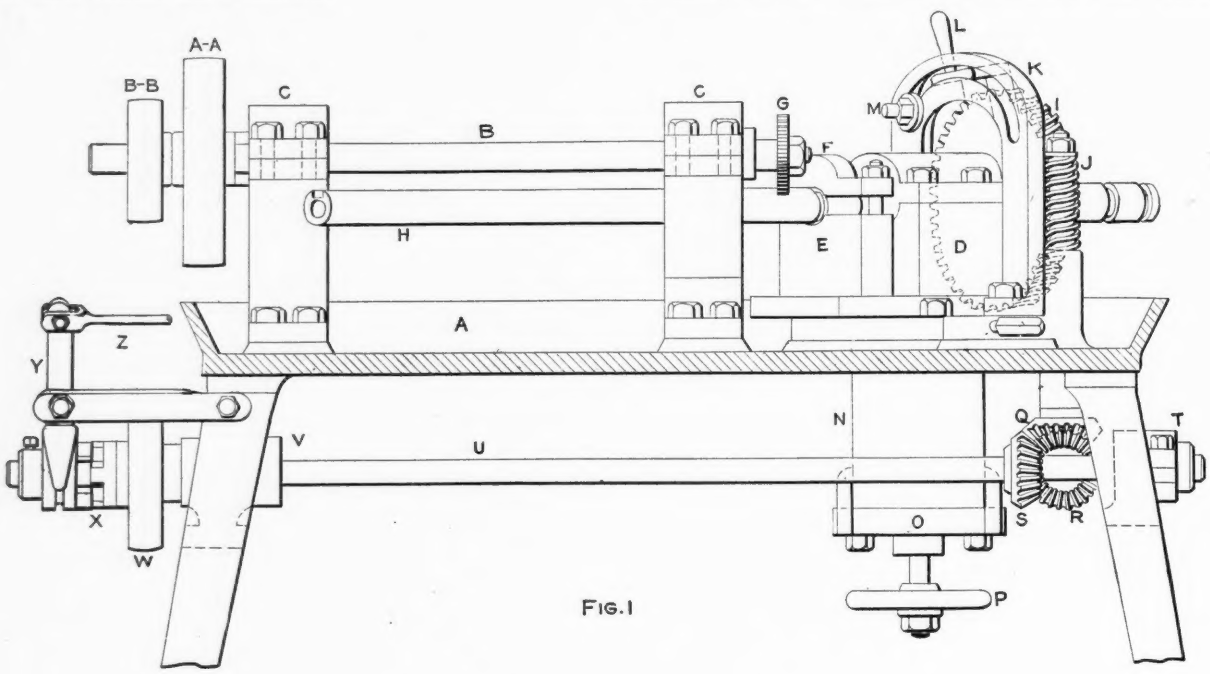


FIG. 1

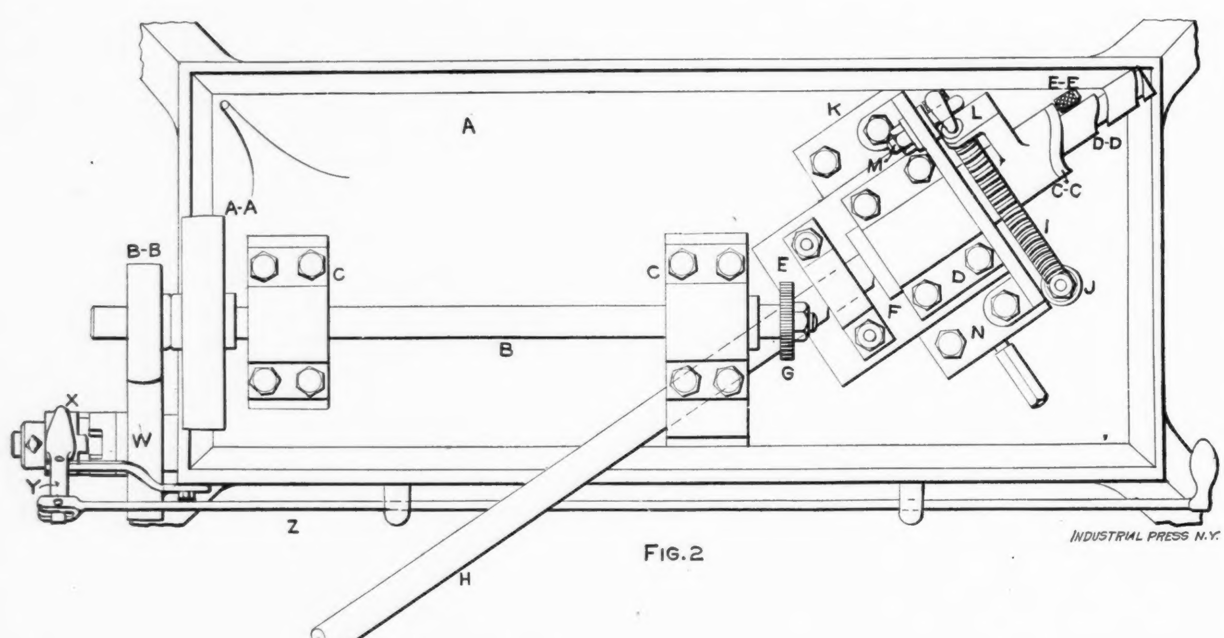


FIG. 2

Plan and Elevation of Screw Milling Machine.

This machine is used for milling 2½-inch pitch threads in 18 feet lengths of 3-inch iron pipe, the wall of which pipe is ½ inch thick. These pipes, or tubes, are used, when assembled with other parts, in a patented boiler tube cleaner for which there is a large demand, and the tubes, before being threaded, have a channel ½ inch wide and ⅜ inch deep cut down their entire lengths. The first lot of tubes were threaded in a lathe, but as this method of doing it was slow, and not consistent with cheapness, the machine shown in Figs. 1 and 2 was designed to do the work.

The design of the machine is clearly shown in the plan view, Fig. 1, and the side view, Fig. 2. The base *A* of the machine is a pan-shaped casting, with a pair of legs fastened at each end, as shown. *B* is the cutter, or driving, spindle, and runs in the boxes *C C* in the position shown. *A A* is the spindle driving pulley, and *B B* a pulley for driving the worm-feed shaft pulley *W*. This feed shaft runs in boxes located in the base at each end, as shown at *V* and *T*, respectively. *X* is the clutch, which is of a simple jaw design, in which *Y* is the yoke and *Z* a section of the starting rod.

The head in which the tubes, or pipes, are fed and held while being cut is situated at the right-hand end of the machine, and it is constructed to allow the work to be set up and the cut started in very short order. Before describing further this part of the machine a few words relative to the method of starting the cut and feeding the tube, so that the required pitch of thread will result, are necessary. The method of beginning the feeding of the tubes into the cutter is as follows: A piece of round machine steel is centered and turned down to 3 inches in diameter and left about 2 feet long. One end of this shaft is then reduced for about 6 inches from the end, to fit tightly within the hole in the pipe, it being finished slightly taper so as to drive in. A square thread of 2½-inch pitch is then cut along the entire length of the shaft. This thread is finished

as smoothly and accurately as possible, thus giving a master screw to work from. A channel is then cut down the length of the screw in exact duplication of that in the pipes. By driving the reduced end of the master screw into one end of a length of pipe, with the channels of both in line with each other, the thread is ready to be milled.

The master screw is inserted into the head *D*, Fig. 2, and projects through far enough to allow the split nut *C C* to engage the first thread, and a feather on the inside of the worm-wheel shaft fits within the channel of the screw. The split nut *C C* is then locked by the knurled-head pin *E E* and the head raised by handle *P* until the cutter *G* has entered one of the threads of the master screw far enough to just touch its bottom. The feed shaft clutch is then thrown in and the worm-wheel *I* revolved by the worm *J*, which is driven by the bevel gears *S* and *R*, as shown in Fig. 1. As the worm-wheel revolves it carries the master screw and pipe *H* with it, and the split nut *C* C, Fig. 2, remaining stationary, causes the screw to be fed forward until the cutter *G* has left the master screw and started to cut the pipe. As the work is fed further through the head the master screw leaves the nut, and the nut engages the thread cut and duplicated on the pipe and feeds it along until the whole length of pipe is finished. As shown in Fig. 2, the split, or feed, nut *C C* is fastened to the face of the sleeve *L*, which rests against the stop stud *M*, as when the cutter *G* is milling the thread the pull is all backward and it is not necessary to fasten the sleeve, the pull causing it to hug the face of the worm-wheel. Before starting the cutter it is necessary to set the thread of the master screw in line with it; to do this all that is required is to adjust the stop pin *M* by moving it backward or forward in the slot in the stop bracket. By so doing the nut sleeve *L* is moved accordingly, and the screw drawn in or out, as may be required, for the necessary distance.

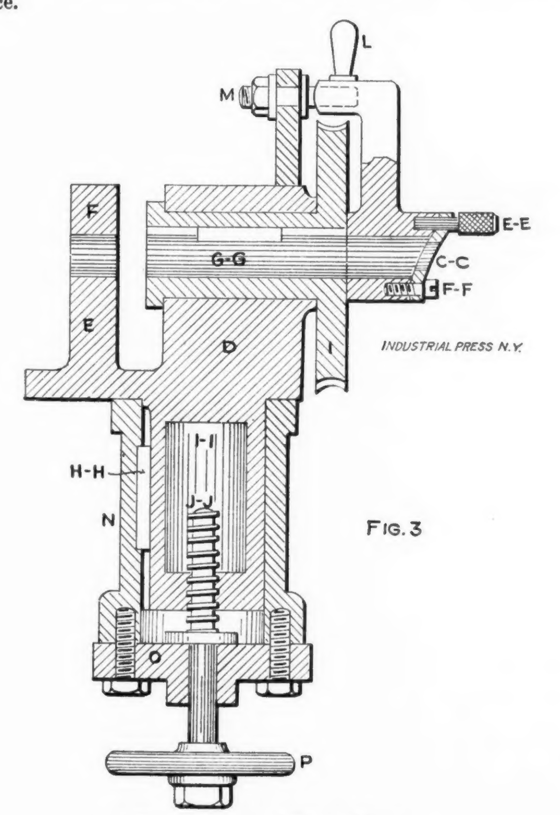


Fig. 3. Sectional View of Head.

In Fig. 3 is shown a cross-sectional view of the head complete. The base *N* is bored out and a feather inserted at *H H*. This feather enters the channel in the round portion of the head. This round portion is cored out at *I I*, and has a hole tapped with a square thread in the bottom to accommodate the raising and lowering screw *J J*, which screw is rested on the inside face of the strap *O*, as shown. The worm-wheel and shaft *I* is all in one piece of cast iron, and was first chucked and bored out to an easy fit for the master screw and pipe; it was then driven on an arbor, and turned and finished, so that the shaft portion would fit with the box, as shown. It was then removed from the lathe and the worm-wheel hobbed in the milling machine. The channel for the feather *G G* was let in, in the key-seater.

When in operation it is surprising the amount of work that this machine turns out, as when the cut is started and an oil pump placed so that both cutter and work are flooded, the machine finishes the entire length of thread without any attention. Mr. Doncaster is now working on a machine which he promises will be a great improvement over this one, as it will be so constructed as to allow the milling of long screws of any pitch. He intends using it, when finished, for milling extra long feed screws for lathes and other machine tools on which screws of this kind are used.

* * *

A NOVEL ELECTRIC LIGHTING PLANT FOR THE EXPLORING SHIP "DISCOVERY."

The exploring steamer Discovery has taken out with her to the Antarctic regions probably as unique an electric lighting plant as has ever been installed upon any ship. The absolute necessity of economy of fuel of every description on account of the impossibility of its replenishment in those regions made it advantageous to adopt a method of driving the generators used for the supply of electricity without the employment of steam. The great difficulty hitherto found in using wind as a motive power for electric purposes has been that the dynamo could not be made to run at a constant speed, due to the fluctuations in the speed of the wind; but this difficulty has been overcome, and the windmill thus rendered practicable for this service.

The difficulties introduced by the varying speed of the windmill have been removed by using two generators, the one opposed to the other when mounted on the same shaft, with the result that with the dynamo running at a speed varying from 500 to 2,000 revolutions per minute, a practically constant voltage was obtained.

The entire plant is very compact, and is so designed that it can be stored away in the hold of the ship until she arrives at her destination. In the event of it becoming necessary to light observation cabins or instrument sheds in the vicinity of the vessel, flexible cables have been provided with lamps attached so that these may be illuminated from suitable plugs placed about the ship. The windmill is so designed that it can be placed complete with its dynamo at a distance of 200 yards from the vessel for the purpose of obtaining the very best results from the wind, and connected to the vessel by means of a large armored cable wound on a drum.

The windmill is 20 feet high, with a driving wheel 12 feet in diameter, developing in a 15-mile wind something like 3 horse power, geared to drive the vertical shaft at 200 revolutions per minute. Commander Scott will thus be insured a good light when steam is out of the question, driftwood not to be depended upon, and the burning of oil or blubber impossible.

The windmill was manufactured specially for this plant by Messrs. Alfred Williams & Co., of Old Ford Road, Bow, and is of American type, so constructed that it can be easily shifted from one point to the other or packed away in a small compass. The apparatus was designed by Mr. Arthur Bergtheil, of Messrs. Bergtheil & Young, British representatives of the Bullock Electric Manufacturing Co. and the Wagner Electric Manufacturing Co.—*Electric Review*, London.

* * *

A statement is going the round of the British press to the effect that Galloways, Limited, of Manchester, have bought out absolutely a patent by Mons. Raoul Pictet, the Swiss inventor. The discovery credited to Mons. Pictet consists of taking out of atmospheric air oxygen by physical and not by chemical means. Mons. Pictet claims that by this process the cost of oxygen will be very much less than ¼ penny per cubic foot, which, when compared with present prices, is in the proportion of cents to dollars. It will be applied to metallurgy, chemistry, lighting and public health. It has great heating properties and can be used for smelting all ore containing gold and other refractory metals, a process which it is claimed is much cheaper than any which at present obtains.

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We solicit communications from practical men on subjects pertaining to machinery, for which the necessary illustrations will be made at our expense. All copy must reach us by the 5th of the month preceding publication.

NOVEMBER, 1901.

CIRCULATION STATEMENT.

MACHINERY reaches all classes—journeymen, foremen, draftsmen, superintendents and employers: and has the largest paid circulation in its field in the world. Advertisers will be afforded every facility to verify the statement of circulation given below.

1900.		1901.		1901.		1901.	
Dec.....	27,500	Mar.....	30,000	June....	28,000	Sept.....	28,165
Jan, '01..	27,500	April....	26,000	July.....	28,964	Oct......	28,345
Feb.....	26,500	May.....	26,500	Aug.....	29,492	Nov.....	31,743

No other paper in this field prints its circulation figures.

Beginning with this month we shall issue a monthly paper for railway shops, called RAILWAY MACHINERY, which will be a consolidation of MACHINERY and THE JOURNAL OF RAILWAY APPLIANCES, and will contain all the reading matter published in MACHINERY, with additional pages specially pertaining to railway shop work. MACHINERY will continue to be published as before in the same form and at the same price, but subscribers to RAILWAY MACHINERY will receive all the general machine shop articles now published in the former paper, and in addition a liberal amount of practical matter dealing directly with the methods and devices in use in the railway machine shops of the country. The price of RAILWAY MACHINERY will be $1.50 a year.

* * *

PROPOSED INCREASE IN A. S. M. E. DUES.

The indications are that there will be a lively time next December at 12 West Thirty-first street, New York, during the annual meeting of the American Society of Mechanical Engineers. The council of the society has always provided an attractive program for the mid-winter meetings, but no plans in recent years have had anything like the possibilities in the way of entertainment to be found in those for the coming meeting. The particular feature likely to prove interesting is the effort that will be made to carry through a motion to increase the annual dues of members and associate members from $15 to $25 and of junior members from $10 to $15. If this motion is pushed with any degree of energy it is safe to predict that the discussion will afford all the entertainment the most ardent members could desire—unless, indeed, those present are so overwhelmingly opposed to the motion that there will be no opportunity for discussion. We certainly cannot imagine that opinion will be overwhelmingly in favor of the motion!

There are now not far from 1,700 members and 500 junior members in the American Society of Mechanical Engineers and the proposed increase in dues would make about $20,000 additional funds to be subscribed and disposed of annually. Obviously such a step is of too great moment to the society to be taken without the most careful consideration, and opportunity ought to be afforded every member to vote upon the question. Under the present rules this cannot be done, however. The rules provide that an amendment may be made by a two-thirds vote of the members present at any meeting, provided a written notice of such amendment be given at the meeting previous. This form has been complied with and there the matter dropped until a short time ago, when circulars were sent to every member, in which were summarized the considerations that led the council to propose the increase in dues. The circular was not sent out until this fall because more attention would naturally be given it now than during the vacation months. Before the winter meeting it is to be followed by a second circular, accompanied by a blank on which the members will be requested to write their approval or disapproval of the change. While these expressions of opinion will have no legal effect, they will exert a moral influence, and it is hardly to be supposed that the vote at the annual meeting will go contrary to the expressed written opinion of the majority of the members at large.

The circular upon the subject of dues which has been issued to members appears to us to be noteworthy for eloquence rather than argument. When stripped down to the kernel there are apparently two main reasons why the council wishes to raise the dues 66 2-3 per cent. The first is that, as now run, the expenses of the society are about five dollars per member more than each member contributes through his annual dues, the deficiency being made up by rentals, sale of papers, initiation fees, etc.

In a recent editorial the *Engineering News* presents statistics to show that the dues of the Mechanical Engineers are now as high or higher on the whole than any other engineering society in the world, except in isolated cases where resident members may be charged an additional sum to accord with their greater privileges. Why cannot our society also be conducted within these limits? No outsider can undertake to say where curtailment should begin, but we advocate a reduction in the expenses somewhere; and then, if the members are not satisfied with the returns, let the complaints and requests for increase in dues come from outside the administrative circle.

The second reason, as expressed in the circular, is because "some more satisfactory housing of the society and its library will have to be considered before long." But should the non-resident members who derive only indirect benefits from the society's house be taxed to meet the expenses of new or enlarged quarters? Would not the mechanical engineers' proportion of the running expenses of a "union" society house, such as has been suggested, be less rather than more than the present expenses? And furthermore, Why add to the expenses of the headquarters simply because more room is needed during the one week of the New York meeting, when an auditorium could be hired at moderate expense for these meetings?

It should be plainly understood that a majority of the members attending the New York meeting have the power to increase the dues of the society and that if this is done those who do not attend the meeting have no recourse but to pay the increased dues, or resign. While we have no idea that the motion can be carried, it is more likely to receive a favorable vote at a New York meeting than at a spring meeting at some other place, owing to the character of the attendance at the annual meetings. It may not be appreciated by many who attend that the additional sum of $10 per year, or $25 in all, would be a positive burden to the large majority of active engineers who are in moderate circumstances, but are doing important work. To show that the fact is not appreciated by the council we have but to quote from the circular to the effect that "It is felt that to practicing engineers this increase is practically nothing."

* * *

In the September number of MACHINERY was published a description of a new type of the Richards side planer, and from the number of inquiries that we have received it has evidently attracted considerable attention. In this planer a departure is made by driving the traveling head through a worm operating in a rack instead of by a screw as usual. This design was originated by the Richards Machine Tool Co., of London, and we are informed by them that they are about to negotiate for its manufacture in the United States. They also write us that the planer is patented in this country.

NOTES AND COMMENT.

Some idea of the tremendous traffic across the Brooklyn Bridge may be gained from the fact that the trolley car tracks wear out in two years, during which time more than 2,500,000 cars have passed over them. Besides the trolley car tracks are those for the bridge cars and the elevated trains which carry many more passengers.

The shop of the Waterbury Tool Co., Waterbury, Conn., was burned out on the night of August 7. The machine room was gutted and the office badly damaged. The fire was checked, however, before the building was totally destroyed, and most of the machines will be able to be used again with repairs. The loss is covered by insurance, and the company are rebuilding, with the intention of at once resuming business.

Mr. Henry Prentiss, Jr., for the past seven years assistant treasurer of the Prentiss Tool & Supply Co., New York, and acting manager of the office, died on October 10th after an illness of only two weeks. He was the son of the founder of the company with which he was connected, and was a man of fine character and marked business ability. He was born February 9, 1876, in Brooklyn. His home was at Rutherford, N. J., and the funeral and interment were at that place. He attended Stevens Institute for two years, and had a broad knowledge of mechanical matters as well as an extensive acquaintance among the machine tool trade.

The Plant System have ordered from the Baldwin Locomotive Works a four-cylinder compound locomotive with the low-pressure cylinders between the frames and connected to a cranked axle. The high-pressure cylinders are mounted on the outside of the frames after the usual American practice and are connected to the same axle. The engine will have the Vanderbilt boiler, having a firebox of the circular corrugated marine type. The trial of this type of compound in the United States will be watched with considerable interest. The chief drawback to it appears to be the cranked axle against which there is a well-founded prejudice when built in the old-fashioned way, but against which there does not appear to be any serious objections when built according to the most approved European plan.

The formal opening of the new works of the Grant Tool Co., at Franklin, Pa., occurred on October 1st. Governor W. A. Stone, of Pennsylvania, and many other men of note were present, and a reception was tendered to the Governor in the evening. The many visitors who were present inspected the new works, and a luncheon was served in the pattern shop after the inspection. The buildings of this plant are new and modern in every respect, and include a machine shop 100 by 250 feet, a factory 80 by 125 feet for the ball department, besides blacksmith shop, pattern shop, etc. A large foundry will be built later. The chief products of the Grant Tool Co. will be lathes, boring mills, drilling, milling and worm-wheel machines, besides many railroad tools. The concern is at present bringing out a new axle lathe, two sizes of vertical boring mills, a wheel press and a steam hammer. Several special machines are being built, such as a large double boring machine for the Allis Engine Works.

The seven clocks designed for presentation purposes by Mr. James Arthur, president of the Arthur Co., New York, and described very fully in another part of this number, are as fine examples of careful machine designing and good machine construction as we have seen. Mr. Arthur does not profess to be an horologer, but he has made the subjects of gearing and fine machine work a study for many years and has applied the principles of good shop practice to the production of these clock movements. As an interesting study of mechanism they can scarcely be excelled and the method adopted to secure a receding action of the gears is one that might prove of considerable value in light-running machinery, where it was desirable to have the gears drive while the teeth were receding, instead of while approaching. Another feature of the movements which characterizes their construction as the work of an engineer rather than of an horologer simply, is the means provided for getting at and removing the different parts without having to take down the whole movement.

Nickel-steel alloy of 36 per cent nickel has the least coefficient of expansion of any known metal, being only one-thirteenth that of iron, or about .0000005 for one degree F. This remarkable freedom from variation of length under a variation of temperature has caused the quite general adoption of nickel-steel of about the stated percentage of alloy for the pendulum rods of high-grade clocks. With the nickel-steel rods no means of compensation for variation of temperature is necessary, the slight changes in the brass bob compensating for the changes in the length of the rod. Nickel-steel also has the valuable property of resisting oxidization or rust to a remarkable degree. It may be exposed for weeks to conditions which would quickly coat ordinary iron or steel with a thick coating of rust, without showing more than minute specks of rust. If nickel should ever be discovered in quantities sufficient to greatly cheapen its present cost, it would have an important influence on the future steel construction as nickel-steel would be generally used because of its toughness, superior strength and freedom from rust, the great disintegrator of modern metal structures. Railway rails having an alloy of 36 per cent of nickel would require practically no allowance for expansion between the ends since the total expansion of a mile of track from 20 degrees below zero to 100 degrees F. would be only 3.8 inches.

The Beaumont oil field in Texas is one of the wonders of the world. There are now sixty-four producing wells, which are conservatively claimed to have a daily producing capacity of 50,000 barrels each, making the total daily production the astounding figure of 3,200,000 barrels, or the equivalent of nearly 1,000,000 tons of coal in calorific capacity. The oil sand is forty feet deep and of considerable area. Some enthusiastic oil producers say that the production of this oil territory will revolutionize the fuel question, especially for power plants and locomotives, since the fuel oil which these wells produce will drive coal out of the market because of its cheapness, freedom from smoke and convenience in firing. There is now great excitement in Louisiana over the discovery of oil wells which seem to rival those in the Beaumont field. It is extremely improbable, however, that these phenomenal gushers will continue producing such enormous quantities for more than a comparatively short period. It has always been the case that heavy producing wells are short-lived, while the moderate producers have a much longer period of profitable flow. There are recent indications which show that these wonderful wells are likely to be no exception to the general rule.

A writer in the *Outlook* gives a brief description of a proposed suspension bridge across the Hudson River from Hoboken, N. J., to Twenty-third Street, New York, which has been approved by the War Department and granted a charter authorizing its construction by Act of Congress. The bridge is the design of Mr. Gustave Lindenthal, an eminent engineer, and is a stupendous conception. It crosses the Hudson by a single span 3,100 feet long, the towers being within the pier line limits. The towers supporting the cables will be 600 feet high above the water level. The bridge will have three decks, the upper one for foot passengers and the other two for railway tracks. The middle deck will carry six railway tracks and the lowest deck, eight tracks. Besides the railway tracks there will be roadways for vehicles and a bicycle path. The estimated cost is $25,000,000 which seems low for such a mammoth structure. It is certainly much less, relatively, than the cost of the East River suspension bridge. It will be constructed by one of the largest railway systems of America and the beginning of the work only awaits the co-operation of the other railways entering Jersey City. The great cost of the structure makes necessary its use by all these roads in order that it shall be a paying investment.

SPIRAL GEARING HELPS.

E. M. WILLSON.

There has been much written about spiral gearing, and many calculations have been made upon the subject, but so far as the author has found, one must go through a lot of figures to obtain the desired result whenever a spiral gear is to be laid off or figured.

While there are many possible combinations of spiral gearing, it is proposed to deal only with gears having an angle of spiral of 45 degrees, as probably that angle is used three times while any other is used once. By using the table herewith, the necessary shop calculations for spirals with an angle of 45 degrees are not much more intricate and do not take much more time than calculations for spur gearing.

Diametral Pitch.	Depth to be Cut in Gear.	Thickness of Tooth at Pitch Line.	Corresponding Circular Pitch of Spur Gear.	Corresponding Circular Pitch of 45° Spiral.	Corresponding Diametral* Pitch of 45° Spiral.	Reciprocal of Diametral* Pitch of 45° Spiral.
	C	$\frac{D}{2}$	D	E	$\frac{1}{F}$	F
2	1.07853	.785399	1.570798	2.22142	1.41421	.707106
$2\frac{1}{4}$	.95869	.698132	1.396265	1.97459	1.59096	.628539
$2\frac{1}{2}$	.86283	.628319	1.256638	1.77713	1.76776	.565685
$2\frac{3}{4}$	.78439	.571181	1.142362	1.61559	1.94454	.514259
3	.71902	.523599	1.047199	1.48094	2.12132	.471404
$3\frac{1}{2}$	.61630	.448799	.897599	1 26939	2.47487	.404061
4	.53926	.392699	.785399	1.11071	2.82842	.353553
5	.43141	.314159	.628319	.88856	3.53553	.282842
6	.35951	.261799	.523599	.74047	4.24264	.235702
7	.30815	.224399	.448799	.63469	4.94974	.202030
8	.26963	.196349	.392699	.55535	5.65685	.176776
9	.23967	.174533	.349066	.49364	6.36386	.157134
10	.21570	.157079	.314159	.44428	7.07106	.141421
11	.19609	.142799	.285599	.40389	7.77817	.128564
12	.17975	.130899	.261799	.37023	8.48528	.117851
14	.15407	.112199	.224399	.31734	9.89949	.101015
16	.13481	.098174	.196349	.27767	11.31370	.088388
18	.11983	.087266	.174533	.24682	12.72792	.078567
20	.10785	.078539	.157079	.22214	14.14213	.070710
22	.09804	.071399	.142799	.20194	15.55634	.064282
24	.08987	.065449	.130899	.18511	16.97056	.058925
26	.08294	.060215	.120830	.17087	18.38477	.054392
28	.07703	.056099	.112199	.15867	19.79898	.050507
30	.07190	.052359	.104719	.14809	21.21160	.047140
32	.06740	.049087	.098174	.13883	22.62741	.044194
36	.05991	.043633	.087266	.12341	25.45584	.039283
40	.05392	.039269	.078539	.11107	28.28427	.035355
48	.04493	.032724	.065449	.09255	33.94112	.029879

* Or modulus.

In the first column of the table, under the heading "Diametral Pitch," are the numbers corresponding to the pitch marked on cutters used for cutting ordinary spur gears. The letters *C*, *D*, *E* and *F*, at the tops of the succeeding columns refer to the corresponding letters shown on the spiral gear blank in Fig. 2.

In the second column, *C*, are the figures giving the depth to be cut in the gear, corresponding to *C*, in Fig. 2. The third column, *D*/2, gives the thickness of tooth at the pitch line, which is one-half the corresponding circular pitch of spur gears (*D* in column four). The figures in column four, as well as being the circular pitch of spur gears, are the normal pitches of spiral gears; that is, the pitch measured on the pitch circle, or cylinder, at right angles to the direction of the teeth (*D* in Fig. 2). The figures in the first four columns apply to spirals of any angle, and the figures in the fifth, sixth and seventh columns apply only to spirals of the 45-degree angle.

The fifth column, *E*, represents the distances from one tooth to the next, measured on the pitch circle, not measured as before at right angles to the direction of teeth, but at 45 degrees to that line and at right angles to the axis of the gear. It is the actual circular pitch of the spiral gear *E*, Fig. 2. For example, if you are to use a 10-pitch cutter and want to find the diameter of a 45-degree spiral gear, we have from column five 0.44428 times the number of teeth and divided by 3.14159, or multiplied by 0.31831, will give the pitch diameter.

Inasmuch as there is a corresponding circular pitch for diametral pitch cutters, and *vice versa* in the case of spur gears, there must also be a diametral pitch, or modulus, corresponding to the circular pitch of 45-degree spirals, or of spirals of any other number of degrees as far as that is concerned. This diametral pitch is given in the sixth column, 1/*F*, for 45-degree spirals, and is generally called the modulus of the spiral, and is equal to 1 divided by *F* (*F* in Fig. 2). This, for example, in 10-pitch cutters is

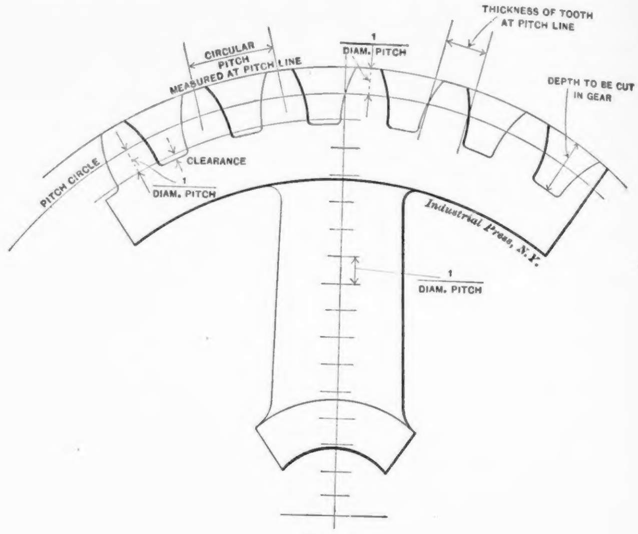


Fig. 1.

7.07106; then the number of teeth in the spiral gear divided by 7.07106 is equal to the pitch diameter.

Or, to work the same thing another way, which some will prefer, taking the reciprocal of the modulus as given in the seventh column, which is *F* in Fig. 2, and multiplying this by the number of teeth will give the pitch diameter. In 10-pitch gearing, 0.141421 times the number of teeth equals the pitch diameter.

The outside diameter of the spiral gear is obtained from the pitch diameter the same as in spur gearing by adding to the pitch diameter 2 divided by the diametral pitch as given in the first column. We will now refer more particularly to the various illustrations.

In Fig. 1 the various parts of the teeth of a spur gear are indicated, and in Fig. 2 the parts of the teeth of a spiral gear are indicated by letters, the explanation of which is as follows:

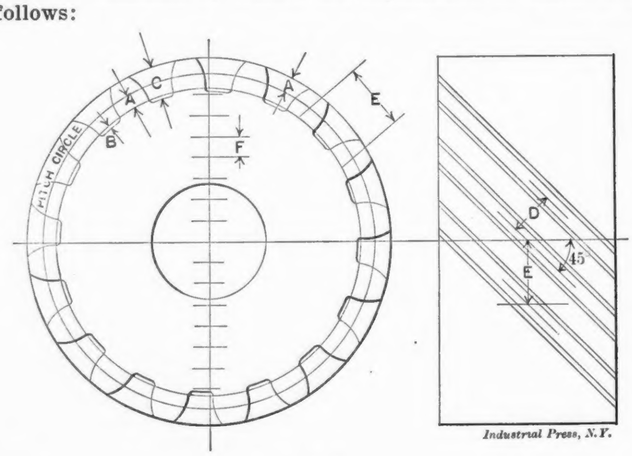


Fig. 2.

The depth *A* of the addendum or dedendum of the teeth equals $\frac{1}{\text{spur diametral pitch}}$; that is, $\frac{1}{\text{pitch}}$ measured according to the diametral pitch of spur gears.

The clearance *B* is measured according to the diametral pitch of spur gears.

The total depth, *C*, of the tooth is measured according to the diametral pitch of spur gears.

The normal circular pitch *D* is measured according to the circular pitch of spur gears.

The spiral circular pitch *E* is measured on the pitch circle.

The quantity *F* is termed the modulus, and is equal to one

space on the pitch diameter of a spiral gear for each tooth. It is calculated by dividing 1 by the spiral diametral pitch, or modulus.

Fig. 3 shows the relative positions of a gear blank, the cutter and the cutter arbor in milling the teeth of a spiral gear. In Fig. 4 is shown how the elements of a spiral gear may be laid out graphically, and the similarity between the lines in Fig. 4 and the corresponding parts of the gear in Fig. 3 should be noted.

Referring to Fig. 4, the distance GH equals the pitch circumference, and is calculated by multiplying E in Fig. 2 by the number of teeth in the gear.

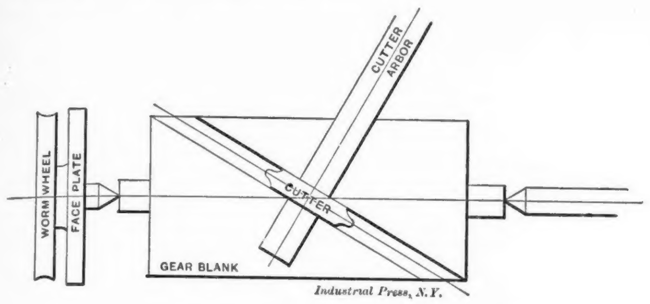


Fig. 3.

The distance HJ in Fig. 4 equals the lead of the spiral gear; that is, the distance traveled by the slide of the milling machine in making one complete turn of the wormwheel, or the gear to be cut (Fig. 3). The distance GJ equals the direction of motion of the cutter.

The distance GK equals the distance traveled, going at right angles to the direction of the cutter, in making one complete turn of the worm or gear; that is, going along the line of the normal pitch of the gear. The angle a is the angle to which the milling machine slide is to be set.

The distance GK equals the distance GH multiplied by secant a. The distance GK divided by the normal circular pitch (D in Fig. 2 and D in table) is equal to the number of teeth for which the cutter should be developed to cut the spiral gear with n teeth.

There is another problem, which many already know, but which some do not; that is, that a spiral gear, when cut with diametral pitch cutters which are developed for spur gears, is not cut with the same cutter that a spur gear of the same number of teeth would be cut with.

By examining Fig. 4 (and Fig. 3 also) you will see that the circular pitch is measured on the line GH, which, let us say, equals the pitch circumference of a gear with 16

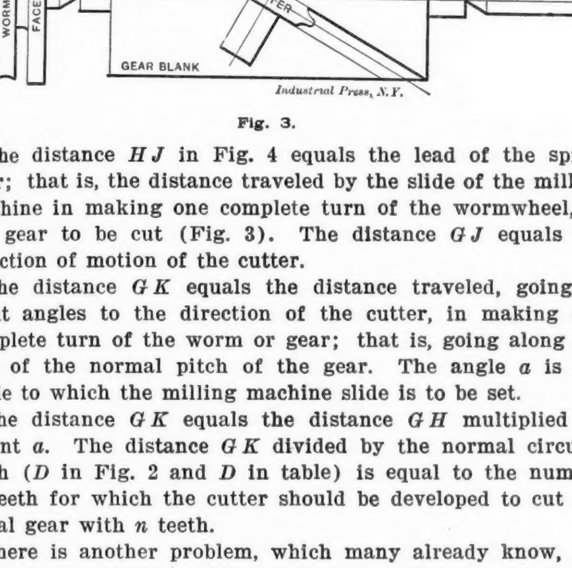


Fig. 4.

teeth cut with a 10-pitch cutter. Now each division on that line equals 1-16 of the pitch circumference. But the normal pitch for our 10-pitch cutter is measured on the line GK, and the normal circular pitch of a 10-pitch cutter is 0.314159; and dividing the line GK by 0.314159 will give us the number of teeth for which our cutter is developed. The same is true of any pitch and corresponding numbers for any angle.

* * *

STANDARD ROLLER CHAINS.

The time to establish a standard is before half a dozen different ways of doing things have been adopted. The automobile and machinery manufacturers of the country are likely to adopt some standard for driving chains in the near future, and the Whitney Mfg. Co., Hartford, Conn., suggest for this purpose the carefully worked-out proportions adopted by them for their new roller chains. Their ¾-inch pitch chains, illustrated in Fig. 1, have the same size of roller that is used in chains of certain other standards, and will therefore interchange on sprockets which have been cut for other ¾-inch pitch roller chains. The rollers should not be larger than 15-32 inch in diameter on a ¾-inch pitch chain, as it would make the sprocket teeth too thin.. For sizes above 1-inch pitch the Whitney chains have larger rolls than used

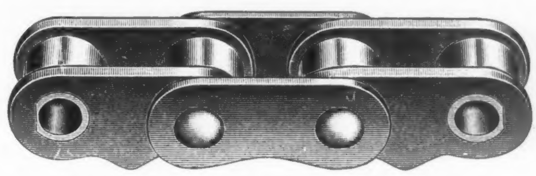


Fig. 1. Three-quarter inch Pitch Roller Chain.

on other chains of corresponding pitch, since there is a gain in the use of large rolls, rivets and bushings, and it is found that the sprocket teeth are sufficiently thick in these larger sizes when the large rolls are used. The standards adopted

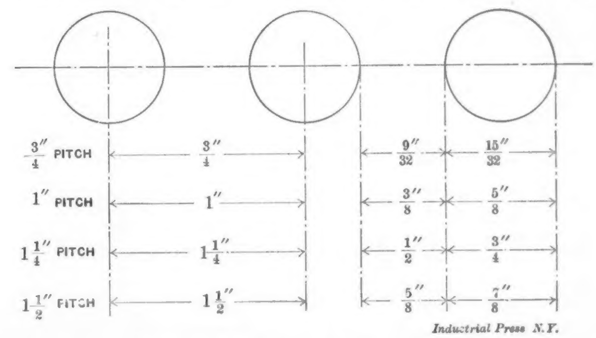


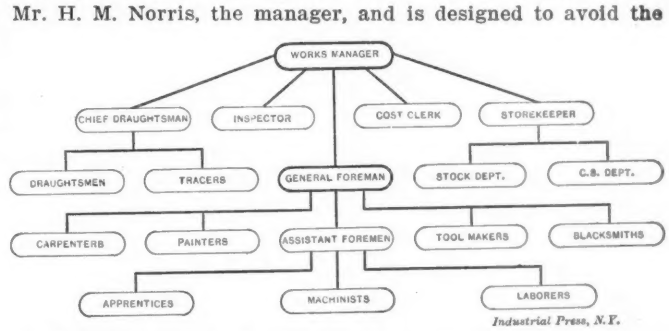
Fig. 2. Standards adopted for Roller Chains by the Whitney Mfg. Co.

by this firm are clearly shown in the sketch, Fig. 2. The dimensions are such as to make the chains very durable, which is an important consideration when they are used for automobile work.

* * *

A SHOP FAMILY TREE.

The accompanying diagram is reproduced from the *Iron Trade Review* and is a copy of a blueprint conspicuously displayed in the several departments of the Bickford Drill and Tool Co., Cincinnati, O. It is said to be the idea of Mr. H. M. Norris, the manager, and is designed to avoid the



friction and conflict of authority between the heads of departments in a shop organization. The diagram is so evidently plain in its meaning that "he who runs may read," and he who reads will be discouraged from trying to "run" those over whom he has no authority.

* * *

The International Correspondence School, Scranton, Pa., have added courses in French, German and Spanish. Instruction in these subjects is given almost entirely by the aid of a phonograph, each student being supplied with one upon commencing his course. The lessons are sent out in the shape of records and pamphlets—the one a key to the other—each record being a master record bearing the voice of the native instructor. After studying his lesson, both from the pamphlet and the record, until he has thoroughly mastered it, the student recites into the phonograph, using one of the wax cylinders furnished him, and returns it to the schools. These examination records show exactly the student's progress—whether he is acquiring ease, fluency, correct articulation, distinct utterance, etc. The records are carefully examined by his instructor, who writes the student letters of criticism and suggestion. Thus the work goes on lesson by lesson to the end.

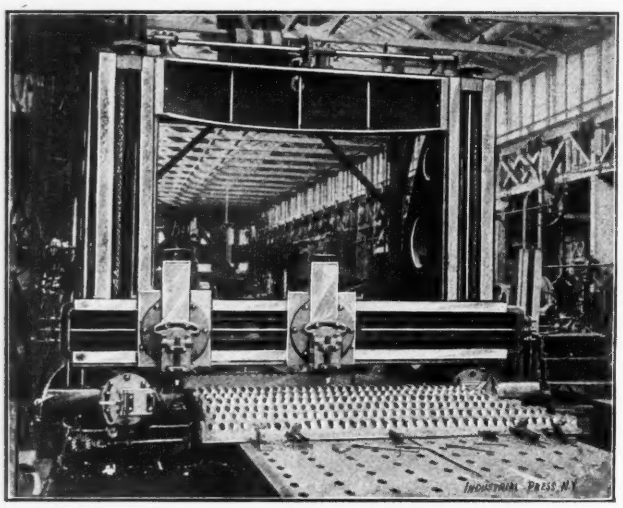
LETTERS UPON PRACTICAL SUBJECTS.

CUTTING A LARGE RACK.

Editor MACHINERY:

The accompanying cut shows how a rack of huge proportions was cut. The machine used for cutting was a 12-foot planer. The rack was made in six sections, five for 30 teeth and one for 31. The pitch was 4 inches and the face 10 inches, and it was cut from forged steel, as an enormous strength was required of it. The rack is now being used on a large forging planer in one of the largest steel works in the East.

The tool holders were placed from the spacing jig, which can be seen behind the last section of the rack. An attempt was made to cut out a triangular piece between the teeth



Method of Cutting Large Rack in Planer.

by using a thin tool set on an angle, which cut first one side of the gage and then the other; but this had to be given up, as the tool would not stand so much side pressure after reaching any depth. Therefore, a ⅝-inch tool was used in the center and larger tools afterwards applied. Then a side tool was used for cutting off the corners. A formed tool shaped up the space to within a few thousandths of the exact shape, and this was completed by a tool of proper shape.

As an interesting fact it may be stated that by actual timing it took 305 hours to cut this rack, or 1 hour and 40 minutes for each tooth. "MACHINIST."

* * *

GEAR PATTERNS AND BLANKS—CALIPERING WORK WHILE IN MOTION—CLEARANCE ON THREAD TOOLS.

Editor MACHINERY:

The MACHINERY data sheet for September contains the kind of information that most machinists like to have at hand for reference. The same could, of course, be said of all the other MACHINERY data sheets, but this one in particular appeals to me.

The value of Grant's Odontograph might not be apparent at first thought, as ordinarily cutters for gears are bought directly from gear makers; but some time or other a special gear may be wanted for which cutters are not at hand, and perhaps the makers, even, do not happen to carry that particular shape of cutter in stock. In such cases a "fly" cutter may easily be made to a template, which is quickly made from Grant's Odontograph method.

I remember once making a pattern gear of 1-inch circular pitch by this method. In this case a piece of steel was forged with a projection for a tooth, as shown in Fig. 1. It was then bored, squared up and marked from a template, and then turned in the lathe nearly to the line. The relieving and finishing was done with a file. The teeth of the gear were first roughed out in the gear blank with another cutter before this cutter was used. The gear in question was used as a driving pinion, and, when finished, made a satisfactory job.

The formulas given in the same data sheet for bevel gear blanks, however, do not furnish quite all the information required for turning up the blanks. The length of face F is not given directly, so that the machinist would need either to measure the drawing or to make the necessary calculations to obtain it. The length of the face is usually made one-third of the distance from its outer edge to the point where the shaft center lines meet at C, or one-third of H, as given

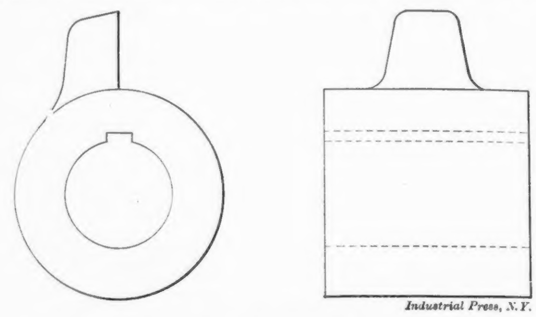


Fig. 1. Cutter made from Template for Special Gear.

in the drawing, which is reproduced in Fig. 2, and if the teeth are to be cut with a rotary cutter this length should not be exceeded, as, according to the Brown & Sharpe catalogue, their cutters are made for a length not exceeding this proportional distance. This gives a tooth thickness at the inner end of two-thirds of that at the outer end.

The length of face can also be obtained near enough for practical purposes by extracting the square root of the sum of the square of the radii of the pitch circles of the gear and pinion and dividing the result by 3. For example: If the pitch diameters of the gears are 8 inches and 6 inches respectively, the length of face would be:

$$\frac{\sqrt{16+9}}{3} = \frac{5}{3} = 1\tfrac{2}{3} \text{ inches, or say } 1\tfrac{5}{8} \text{ inches.}$$

For miter gears, merely square the radius of the pitch circle, then multiply by 2, extract the square root and divide by 3. The angle of face, or angles O and O', Fig. 2, are not, as given in the data sheet, so convenient for the workman in most cases as their complement, or the differences between 90 degrees and the angles as given, would be. These complements would give the angles measured from a line at

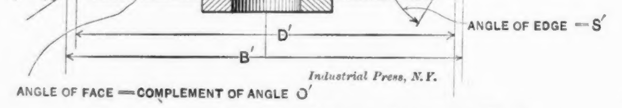


Fig. 2. Drawing for Bevel Gears, from Data Sheet.

right angles with the center line of gears, so that a bevel protractor could then be applied on the back side of the hub of the blank to measure the angle made with it by the face, or, if a compound rest is used, the rest could ordinarily be set direct to the angle as given.

The angle of edge is not given at all, and while this angle is not so important as the other angles, yet it is better to have something to go by in finishing it. If measured from a line at right angles with the center line of gear, this angle is equal to the center angle S or S', respectively, for the gear and pinion, as shown in Fig. 2.

On page 62 of October MACHINERY it says: "Never caliper

a piece while it is in motion." This is evidently a good rule to follow, yet in some cases exception may be taken to it, as in roughing work it may save time to try it by the use of spring calipers without stopping the machine. There is considerable of the "cut and try" method necessary when calipering work in the lathe; it is always possible to turn stock off, but never to put any on, so most workmen will take several cuts before the work is down to the finish size. With a snap gage alone there is no means of knowing just

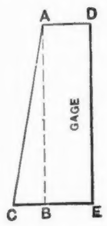


Fig. 3.

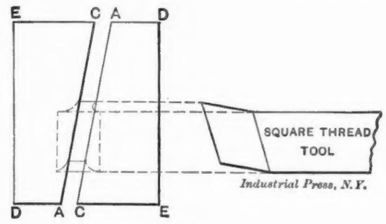


Fig. 4.

how much stock should be removed to bring the work to size; with a micrometer caliper we can tell just how much should be taken off, but still if there is no graduated cross-feed on the lathe we are compelled to guess at it in taking the cut.

Under ordinary conditions, it is convenient to use spring calipers in connection with micrometers or snap gages. For ordinary work the calipers may be set to scale, leaving about 1-64 inch for finishing. If the calipers have wide points, as in outside thread calipers, it is easier to caliper with them. The spring calipers will give a little when very near to size, and lighter cuts should then be taken till the work is down to size. I have found a pair of wide-point spring calipers very convenient when grinding small work to size; the work could be ground to within 0.001 inch with the machine running, and then it could be stopped and the micrometer used to finish with.

It is usual for tool grinders to make the clearance on thread tools by guess, but when that method is not likely to be accurate enough, a gage like that shown in Fig. 3 is convenient and is easily made from a piece of sheet iron or tin. Line *A B*, Fig. 3, of the gage, is taken equal to the circumference of the work, and *B C* to the pitch or lead of thread; then *A C* is inclined at the corresponding angle or inclination of thread. Make the gage of the shape, *A C E D*, as shown, and then it can be used to try the clearance on either side of the tool. Fig. 4 shows the gage applied to a square thread tool. JOHN T. GIDDINGS.

Providence, R. I.

* * *

BACKING-OFF DEVICE FOR THE GRINDER.

Editor MACHINERY:

It is generally known among machinists and instrument makers that hard rubber is a material that gives much employment to the grinding machines when cutting tools are used on it, and it is a fact that duplication of parts made of it is almost, if not quite, impossible; yet it is sometimes imperative to have a close approximation to interchangeability, and it was this necessity that led to the construction of the device shown herewith.

It was found that a taper reamer ground in the usual manner would not ream out many holes before it became dull; and further, that when sharp it chattered, as the depth of the holes did not in any case equal the diameter of the reamers at the small end. With the aid of the device here shown it was found that from six to ten times as much work could be done with a reamer when ground in it than when ground with a concave edge, and that there was no chatter at any time—which, of course, adds greatly to the life of the tool and also effects a great saving of time and material. The device can also be applied to grinding straight reamers and other cutters that can be relieved in the same manner.

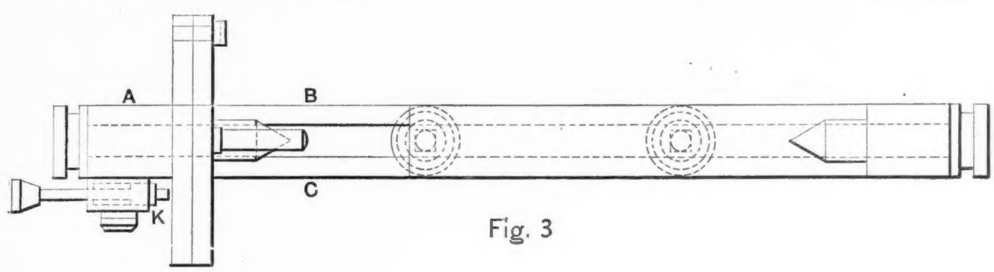


Fig. 3

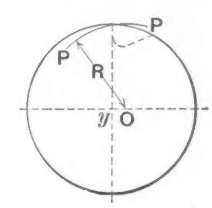


Fig. 4

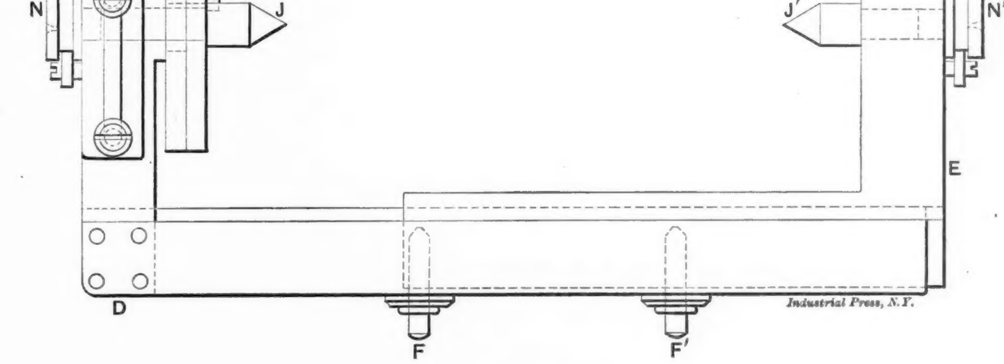


Fig. 1

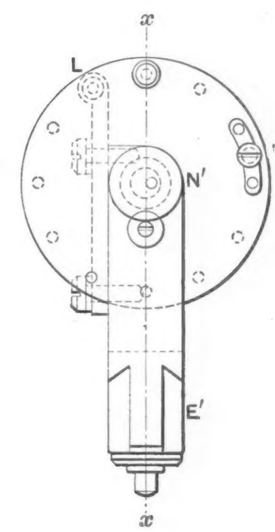


Fig. 2

Backing-off Device for the Grinder.

In the accompanying sketches, Fig. 1 shows a side elevation, Fig. 2 an end view and Fig. 3 a top view of the device. The head and all other large parts are of machinery steel, and the screws, centers and all the small parts except the washers are of tool steel and hardened. The head frame is made of three pieces, *A*, *B* and *C*, Fig. 3, riveted together as shown at *D*, Fig. 1. The top edges of *B* and *C* are beveled to receive the tailstock *E*, Fig. 1, while *E* is milled, as shown at *E'*, Fig. 2, to receive pieces *B* and *C*, and they are locked together firmly and accurately by the screws *F F*, Fig 1. A faceplate *G*, Fig 1, carries a pin *M*, which in turn carries a

specially constructed screw dog. The faceplate is attached to a dial plate *H*, Fig. 1, by screw *I*, Figs. 1 and 2, which arrangement permits adjustment to position for grinding after the reamer is dogged to the faceplate, since the opening in the faceplate is a slotted hole, as seen at *I*, Fig. 2.

The faceplate is made to revolve freely on center *J*, Fig. 1, restrained by the index pin *K*, which is housed in an adjustable bracket *L*, Figs. 1 and 2, and kept in place by a spiral spring. The bracket, being adjustable, allows the index plate to have several circles of holes and permits of nearly all required divisions on one plate. On the index plate shown in the drawing there is only one circle, containing 12 holes.

N N', Figs. 1 and 2, are pieces that have eccentric centers and are adjustable by the flanged screws which clamp them in place. It is seldom necessary to change these centers, once the proper angle of clearance is found.

The operation of this device is as follows: Putting the reamer on the centers *J J'* and dogging to the pin *M*, the device is placed between the centers of the grinding machine and allowed to hang freely in position, and then, by moving the faceplate after loosening the screw *I*, the reamer is so adjusted that the cutting edge is on a line with the center line *x x*, shown in Fig 2. The whole device is then turned until a quarter turn is made and the work brought to the wheel. As broad a face as the wheel will allow should be presented to the work in order to give a smooth cut. Holding the tool by the part *D*, a slight up and-down motion, together with the feed of the screw, will give the result shown in exaggeration in Fig. 4, where *y* is the center of the reamer, *O* the center on which the device is swung, *R* the radius to which the work turns, and *P P* the arc which the work makes in passing the face of the wheel.

Brooklyn, N. Y. J. R. GORDON.

* * *

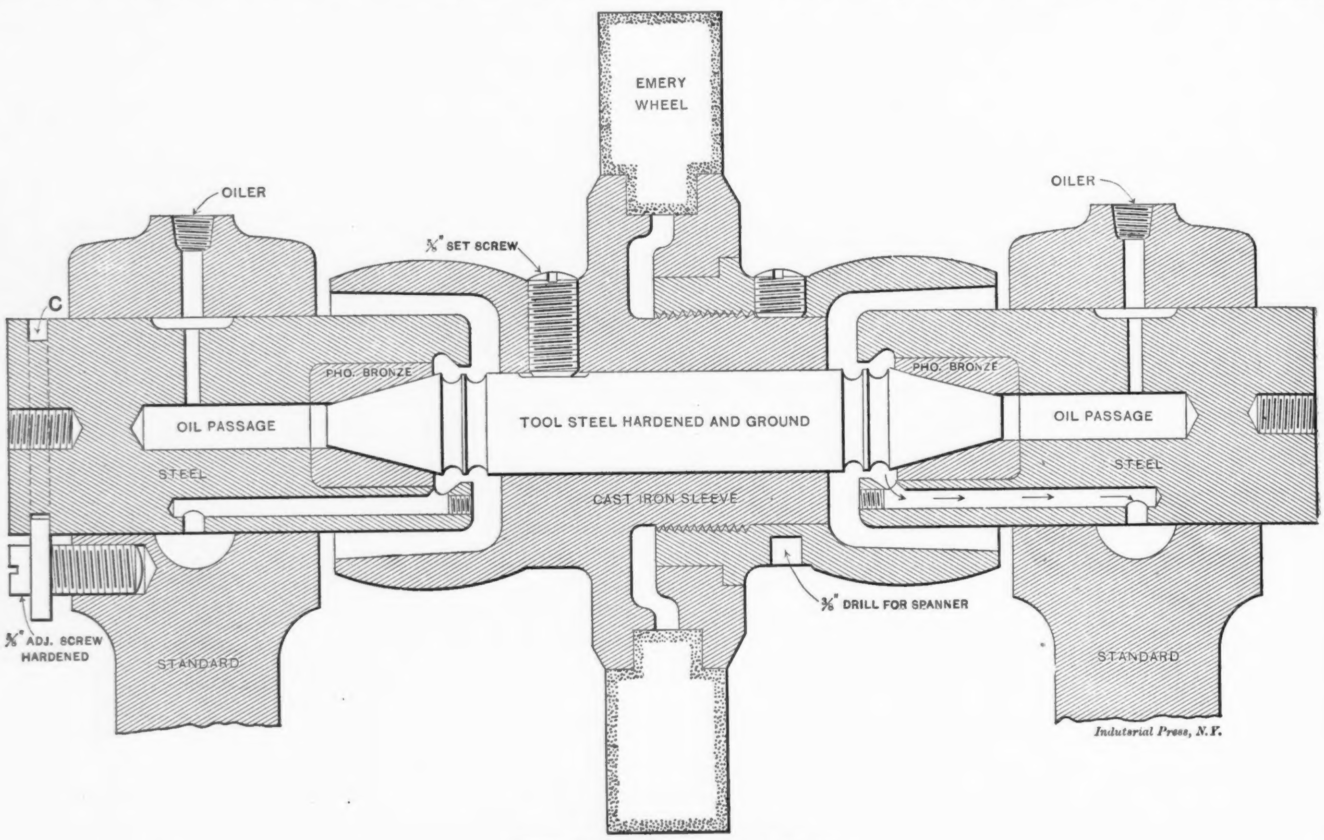
EMERY WHEEL HEAD FOR ROLL GRINDER.

Editor MACHINERY:

The design for the grinder head shown in the accompanying cut is, as yet, experimental, so far as its success is concerned, but it involves some features which we believe to be novel, and not without possible advantages. It is the result of a somewhat unsatisfactory experience with a flour-mill roll grinder, which carried an overhang wheel with taper bearings, which could not be adjusted sufficiently tight to make a finished surface without becoming too hot for satisfactory use. This condition could have been overcome, and, in fact, has been overcome by the makers; but inasmuch as the machine in question was a combined grinder and corrugator, and involved changes between operations, it was decided to use it solely as a corrugator and do the grinding on a separate machine, thus increasing our output more than 100 per cent with no additional labor cost, the proposed grinder being automatic in its operations.

Under ordinary conditions we would hardly attempt to build a machine which could be bought in the open market, but in this particular case it appeared possible to design a machine which would do satisfactory and rapid work at a cost which is far below that of standard machines of similar capacity. The drawing shows a section through the center of the wheel and bearing, and the construction is made sufficiently clear to make it readily understood.

The partial section of the two standards represented as carrying the spindle bearings are part of the yoked cross-slide of the wheel-housing, which has a motion at right angles to that of the table carrying the revolving roll back and forth. There are two grinding heads on opposite sides of the machine, both being used for simultaneous grinding but driven by separate friction clutch countershafts. The bored ends of these standards are split on one side and furnished with binder screws, the finishing cut of the bore being taken at one setting with the holes slightly contracted. The alignment of the two holes is therefore perfect, and the steel bearing plugs, carrying phosphor bronze taper bearings and closely fitted to their respective housings, are correspondingly accurate and subject to easy removal by slightly slackening the binder screw. These steel bearing plugs are provided with suitable recesses and passages for oil, and one of them has an annular channel at *C* which receives the collar of the adjusting screw, thus providing a cheap, but efficient adjustment.



Emery Wheel Head for Roll Grinding.

The spindle is of tool steel, hardened and carefully ground, and is provided with double oil sling, the second one coming into play after adjustment for wear has possibly carried the first into the face of the bronze bearing. This spindle is a close fit in the cast-iron sleeve, which, with its washer and nut, serves the double purpose of emery wheel holder and drive pulleys, the whole being finished to insure perfect running balance.

While the expense of this bearing is considerably in excess

of those in common use, it nevertheless has some advantages, the importance of which is considerable for the special work intended.

The most important point gained is the protection of the bearing from dust and the protection of the wheel from oil. Provision for this purpose, to a still greater extent, is easily made; but until trial demonstrates otherwise the present precautions are thought sufficient.

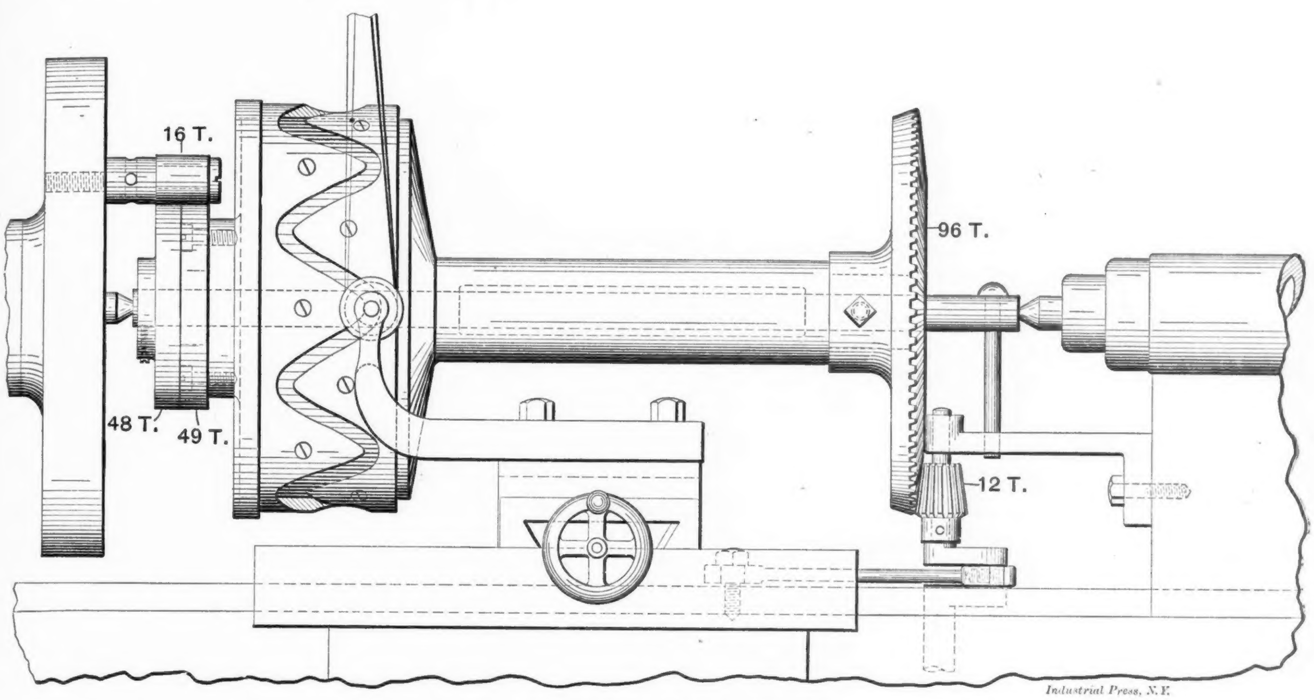
The ease with which the wheel and spindle may be removed and the extreme rigidity of the spindle, combined with a small and easily-adjusted bearing, would seem very advantageous from our limited experience. It is obvious to us that any considerable heating in the journals might cause expansion sufficient to cause the whole spindle to bind; but this and other contingencies can only be in evidence through such experience as we hope to shortly have at our disposal.

WM. H. CORBETT.

Portland, Oregon.

to run on a sectional former, representing a little more than one full loop of the groove and fitted it to be moved from place to place along the periphery of the blank as the work progressed. By causing the table to rotate and carefully following up and down the incline of the former, after the manner of a profiler, a fair job could be made. The locating of the template, however, had to be very carefully done in order to have the groove ends match, while the necessary shifting of the clamps at the successive cuts and blocking up was a hazardous operation. The second cam made by this process was considered sufficiently good after dressing with a hand file.

Shop No. 2 had a lighter milling machine, with no rotary attachment. Their scheme was to make a flanged drum, turned to fill the bore of the blank cam, and fasten these parts together with screws along with a ring having its edge cut to the profile of the whole series of grooves. This drum they attached to the dividing head, blocked up to the necessary



The Way the Cam was Made in Shop No. 4.

AN UNUSUAL JOB.

Editor MACHINERY:

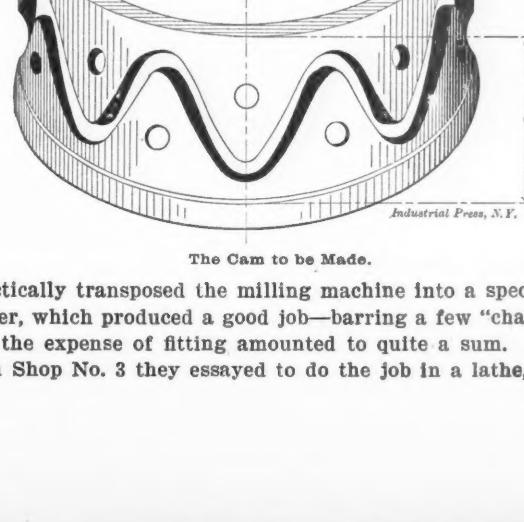
Machinists employed in jobbing shops are often called upon to display their ingenuity by devising ways and means of procedure that are highly interesting. Could these be collated they would afford a compendium of mechanical practice of material interest to others of the craft similarly situated.

True genius is often shown in making uncommon use of common tools by resourceful masters of the craft, at once highly creditable to themselves and satisfactory to those more or less directly interested. It is to be remembered that what might not be tolerated in shops given to *manufacture* of specialties is often commendable in the construction of sample machines and of that class of work usually taken to the jobbing shop. Of such nature is the piece shown—a plain cylinder, having a groove or sinuous channel, with regular rise and drop, running around its circumference. Its dimensions are shown in the illustration. With a special machine it would present little difficulty; with an ordinary shop equipment it is not so easy.

The conditions with the machine it is used upon demand that the groove shall be of uniform width, that it shall be regularly spaced, and that the inner surfaces be smooth. Similar pieces have been made in four separate shops, all devoted to high-grade jobbing, only one of which possessed a cam cutter, and that one not available.

In Shop No. 1 there is a large, powerful milling machine, with rotary table attachment, and their plan was to make a special butt or end mill with short teeth, immediately back of which, on the shank of the mill, they put a roller adapted

height and used a cutter similar to the first described. They also removed the feed screw of the table and arranged a cord, pulley and weight to keep the roller in contact with the former, feeding by revolving the dividing head by hand. This



The Cam to be Made.

practically transposed the milling machine into a special cam cutter, which produced a good job—barring a few "chatters"—but the expense of fitting amounted to quite a sum.

In Shop No. 3 they essayed to do the job in a lathe, fasten-

ing the blank to the faceplate. They figured it out that as the rise and drop was regular, and that there were to be eight loops around the circumference, the motion to the cutting tool might be imparted by a crank, geared to turn in the ratio of 8 to 1 and having a throw equivalent to the mean pitch height of the loops. By placing an arbor between the lathe centers having on it the driving bevel gear and arranging a vertical crankshaft in fastenings secured to the lathe, with the smaller gear thereon, and also provided with a pitman reaching to and secured at the lathe carriage, the necessity of a former was obviated. For a cutter they made a special milling head, fastened to the tool post and capable of being fed in as required. They found upon trial that the speed, even with the back gears in and the belt on the naked shaft, was too high for the cutter to work successfully, although they finally succeeded in producing a fairly accurate job.

In Shop No. 4, profiting by the experience of their predecessors, they selected the lathe as being the most suitable tool, but made a mushroom-shaped casting, turned to fit the bore of the blank and screwed the blank to it. The bore of the mushroom sleeve fitted an arbor held in the lathe centers, but kept from turning. They drove the sleeve by a gear having one tooth more than another of the same diameter fast on the stationary arbor and arranged side by side. The driving pinion ran loose on a stud in the faceplate and rotated around the two gears, meshing with both, and, by reason of the unequal number of teeth in the pair of gears, forced the mushroom sleeve around one tooth for each revolution of the lathe (sun-and-planet gearing), which was as slow as desired, depending upon the speed the lathe was run at. The cutter driving and method of producing a uniform wave motion was as in the preceding method, and is clearly shown in the illustration.

It is difficult to see how this process could be improved by improvised methods, using ordinary shop tools; but perhaps other shops, should this job fall to them, can make further improvements. W .E. Willis.

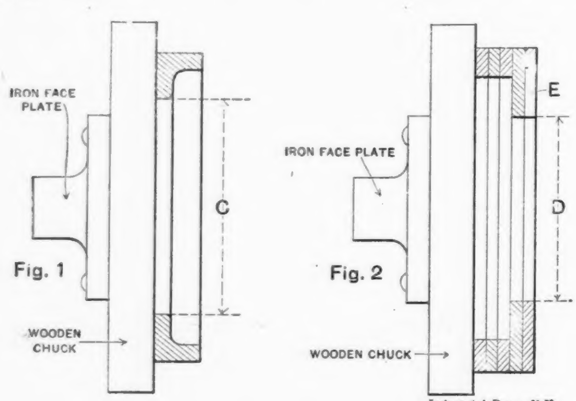
Philadelphia, Pa.

* * *

ANOTHER METHOD OF HANDLING SEGMENT WORK IN THE PATTERN SHOP.

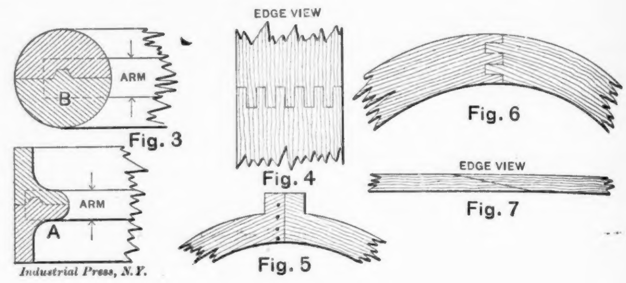
Editor Machinery:

In the October issue of Machinery, Mr. J. L. Gard, in describing the methods of building patterns of gears, pulleys, etc., states that he "puts a face-plate on the arms, builds between the arms, and then builds segments on each side," etc., and then says: "This leaves the segments between the arms to be finished by hand." I am aware that this is the customary method, but the entire work can be done much more expeditiously on the lathe and a better job made as follows:



The Rims on the Faceplate.

Build up the rim in halves. At Fig. 1 is shown the first half in section, the bearing being next to the wooden chuck, or face-plate. The inside is turned out to a template, but the outside diameter is left unfinished; this half pattern is then removed from the chuck. The second half rim is shown at Fig. 2, unfinished, with the parting on the outside. This is trued up and the diameter *D* is bored out to the same size as diameter *C*, in Fig. 1, after which a stick is fitted across tightly and, while the work is revolving in the lathe, the center is carefully located. Then a pair of trammels, or beam compasses, are set at a radius of about ½ or ¾ inch less than that of the finished pattern, and this is used to describe a circle on the arms and also on the parting of the pattern. The arms are band-sawed to this line, and are let half way into each half rim in sockets, as shown in Fig. 2 at *E*. At this stage temporary blocks are fitted into these spaces *E* and this half is rechucked and the inside turned out. It is then removed from the chuck and the two half rims are glued together with the arms glued in between, and when set the outside can be turned off. A hole can be bored in the center of the arms and the hubs turned to fit, so they will be sure to run true.



The Jointing.

It is but a trifle more work to make a tongue on one half pattern, and a corresponding groove on the other one, as shown in Fig. 3 at *A* and at *B*, the round rim pattern. This prevents any tendency for the parts to slip out of center with each other when they are being glued and the handscrews applied.

The method I have described prevents having the ends of the arms project through the rim, thus making smoother work and making the pattern easier to draw out of the mold. In many of the shops in Boston segments are sawed out of 2 or 3-inch stock and tongued on the circular saw, as shown in Fig. 4, edge view. A saw ⅛ or 3-16 inch thick is used to cut out the tongues in this method, which saves many glued joints. These need thick glue in order to get them together easily, and it is a good plan to leave a projection at the ends of the segments, as shown in Fig. 5, so that they can be clamped up tightly with handscrews.

A thin ring might be made of a single thickness, tongued, as shown in Fig. 6, or a stronger job could be made by using a scarfed joint, as shown in Fig. 7, edge view, which is thoroughly glued and clamped together. This latter kind of a joint is frequently used on stove patterns which are often only 1-10 inch in thickness. W. A. Sylvester.

Reading, Mass.

* * *

GRINDING DRILLS.

Editor Machinery:

I have noticed the item on wet vs. dry drill grinding published in your October number, under the heading "Items of Mechanical Interest," and am induced to give my little experience in that line.

It is true, of course, that wet grinding is better adapted to large drills than to the small sizes, for the reasons given in the item, and also because in grinding a small drill the time saved by being able to grind more rapidly is again lost in wiping the drill and also one's hands.

Regarding the selection of the proper emery wheels, I have found this to be practically impossible on account of the great variation in size of the drills ground on the same wheel. Suppose, for instance, a drill grinder with a capacity of ¼ to 2¼ inches to be installed in a shop. What grade and hardness of wheel should be used on that machine? Ask the mechanics who grind their drills on it. The man at the radial drill will want about grade 46 and medium hardness; the man at the sensitive drill, about grade 70 and a harder wheel.

Here we have to compromise; but allow me to state that it is much easier to get a wheel too fine and hard than too soft and coarse, because a little roughness at the cutting edge is far less objectionable than to have the temper drawn

at that point. It frequently happens, after grinding a drill, that the edge appears to be unharmed; but when the thin ragged burr is removed a very perceptible blue can be detected with a magnifying glass. Such a drill loses its valuable initial sharpness as soon as it commences cutting.

The grade of emery in the wheel also is not so important a factor as the hardness of the bond. A hard, coarse-grained wheel will glaze over and heat the drill much more than a less hard and finer wheel. I have frequently ground a No. 60 drill on a medium hard wheel made of No. 46 emery, with very good results, but care must be taken to move the drill holder very slowly so as to obtain a smooth "grind."

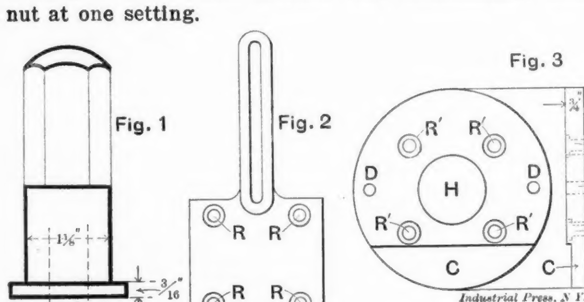
I have alluded only to drill grinding on the machines built for that purpose, as now these are (or should be) used in nearly all shops—especially since the many adjustments which it was necessary to make in the older machine are not required in the latest of these, and drills ground thereon are not only ground in less time but also do more and better work than the average hand-ground drills. But to successfully grind drills on these machines requires common sense, as does anything else around the shop, for these machines cannot, any more than others, be made "foolproof." It must be borne in mind that when grinding a drill by hand it is yieldingly held and the pressure exerted against the wheel is felt by the operator, whereas in a drill grinder the machine takes all the strain and the operator does not feel it and is tempted to grind heavier than is good for the drill. The best way is to grind off the bulk of the metal by rather quick oscillation of the drill, so as to reduce the danger of drawing the temper, and then to finish with two or three slow movements, to obtain a true "grind." DRILLGRINDER.

* * *

A TIME-SAVING METHOD OF FINISHING NUTS.

Editor MACHINERY:

We had a job in the shop a while ago, which I think will be interesting to readers of MACHINERY because of the time saved in doing it. We had about 350 nuts, similar to the sketch, Fig. 1, which were for truing devices for grindstones. They had to be turned and rounded over on the end, as indicated by the heavy lines in the sketch. In the regular way the nut would have had to be put on and taken off the nut-arbor three times, thus involving considerable waste of time. The foreman did not like this idea, so he tried the following scheme which worked very successfully, finishing a nut at one setting.



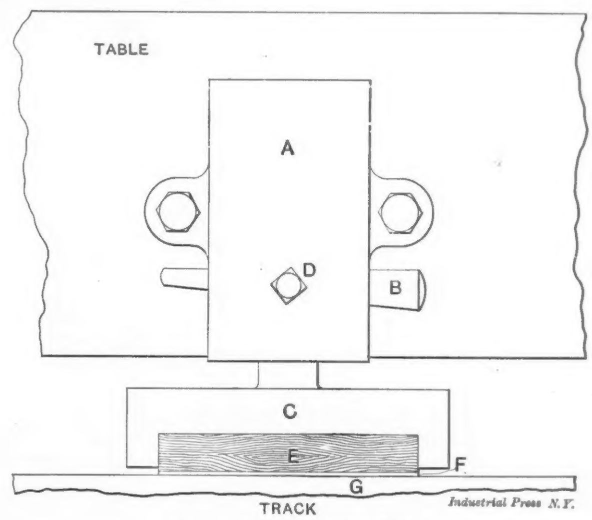
Rig for Finishing Nuts.

We used a Hendey-Norton lathe with the taper attachment, the nuts having been tapped and faced on a screw machine. I got a tap bolt and clamped two Armstrong toolholders in the tool-post rest, then ground and set the tools so that they would turn both diameters at the same time, and then set the thread stop. The tool that turned the small diameter was ground nearly square so that when it came up to the shoulder I could pull out and feed in until it brought up on the thread stop, thus getting a square shoulder. For rounding over the opposite ends an attachment was devised for use with the compound rest. The taper attachment on the cross-feed cover, Fig. 2, was first taken off, and then a cast-iron blank was taken and a hole bored in its center to fit the tit on the compound tool-post rest, as shown at *H*, Fig. 3. It was then put on an arbor and squared until about ¾ inch thick and turned to about the diameter of the graduated part of the compound rest, after which it was placed in a shaper and clearance-planed off, as shown at *C*, Fig. 3. The taper attachment, Fig. 2, was then placed on the blank and the holes *R'* laid out, drilled and counterbored so we could use the same screws again. Then the blank was screwed on the cover, and the compound rest laid in and holes laid out for clamp bolts. The blank was then again taken out and holes were drilled and tapped, as shown at *D D*, Fig. 3, and the whole thing was put together again. A tool post was put in the compound rest and a rounding-over tool turned upside down in the tool post, and then all we had to do was to feed in the rounding-over tool from the back, thus finishing the nuts at one setting and saving at least two-thirds time. A READER.

* * *

SUPPORT FOR BORING MILL TABLE.

During a recent visit to the shops of Mackintosh, Hemphill & Co., Pittsburg, Pa., a large boring mill was noticed which had a rather unusual form of support for the table. The mill in question has an extreme capacity of 36 feet when the housings are set back to the limit, but it is rarely used on work larger than 30 feet in diameter. Some of the work bored and turned on it is very heavy. A heavy stepped nickel-steel gear for a rolling mill was on the table at the time of



Support for Boring Mill Table.

our call which weighed about 30 tons, and work much heavier than this is often carried. One instance was quoted where two flywheels, each weighing 90 tons and 30 feet in diameter, were turned. As the mill is of a pattern much lighter than would now be built for an equal capacity, it is not strange that the supports provided for the table for comparatively light work have been found inadequate for heavy work, and something more durable substituted. At present the table is supported by eight slippers, such as shown in the cut. The socket *A* is bolted to the periphery of the table, which carries the slipper *C* in which is mounted a wooden block *E*. Between the wooden block and the track *G* there is interposed a piece of fiber for a sole. The adjustment of each of the shoes is made by the key *B*, which is held by the setscrew *D*. The arrangement is said to be satisfactory, which is saying a good deal, considering the severe tests to which it has been put.

* * *

Warren E. Willis, Harrisburg, Pa., writes us that he has working drawings of the devices for relieving milling cutters described in the October number of MACHINERY. These devices are applicable to any engine lathe, and prints of the drawings can be furnished to any desiring them. In his article on Cellulose Machines, published in the September, 1901, issue, Mr. Willis tells us that he inadvertently omitted to mention that the credit of the invention of this machine should be given to Mr. George R. Sherwood, of Kearney, Neb.

* * *

Experiments made to determine the loss ensuing by exposing coal to the weather, unprotected in any way, show, contrary to general belief, that it is very small. There was a gain in the amount of oxygen but a loss of carbon, hydrogen and nitrogen; the loss of calorific power was slight.

VAN NORMAN DUPLEX MILLING MACHINE

NEW FEATURES, INCLUDING A NOVEL APPLICATION OF ROPE DRIVING.

It has been known for some time that the Waltham Watch Tool Co., Springfield, Mass., were bringing out a milling machine embodying new features. In the Van Norman duplex milling machine made by this company, the No. 0 and No. 2 sizes of which are now in general use on the market, the cutter head is adapted to be set and operated at any angle from horizontal to vertical, and is mounted on a ram or frame which can be moved in or out over the table in order to bring the cutter into the most convenient position for operating. In the earlier type of these machines the spindle is driven through shafting and bevel gears. The peculiar feature of the new and improved machine illustrated in this number is the substitution of a drive by an endless rope for this gear drive. There is an arrangement of idlers and a take-up device which permits the proper driving of the cutter spindle when set at any angle or position, as will be evident by an examination of the three engravings showing the spindle respectively in a vertical, a horizontal and an inclined position.

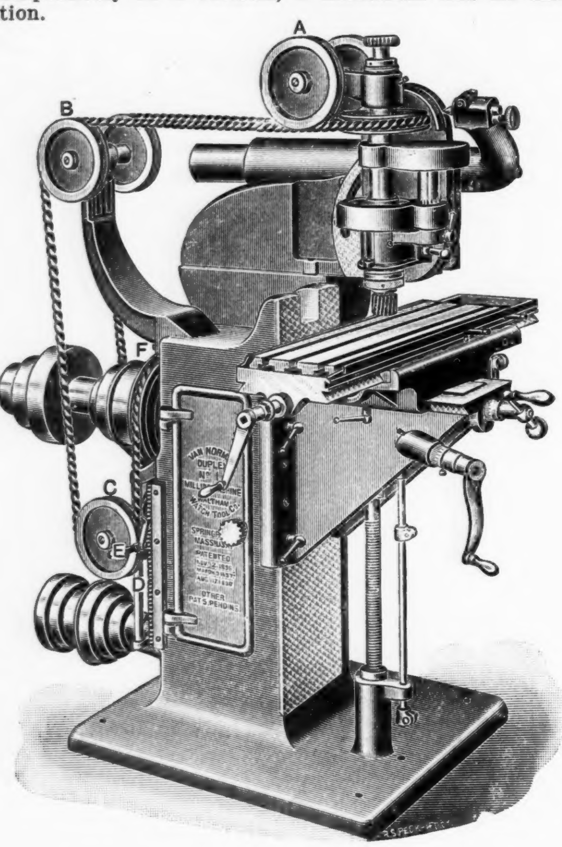


Fig. 1.

The use of a rope drive for a machine that must be driven so uniformly and powerfully and at the same time do such delicate work as a milling machine is a decided novelty. The advantage of such a drive, however, when properly applied is very obvious, since it enables the spindle to be driven directly and with the full power of the machine in whatever position or angle it may be placed. Anything but an endless belt, of course, would be out of the question on account of the "jump" when the coupling passed over the spindle pulley. The advantages of the rope drive have been apparent to Mr. Van Norman, the president of the company, for a long time, but it was not adopted until an endless rope was found of perfectly uniform texture and that was flexible enough to pass over pulleys of small diameter. Such a belt, however, has now been found, and extensive experiments with it have shown it to be satisfactory for even the most delicate high-speed milling. It is made of narrow rawhide lacings, woven into rope form, and makes a very smooth running, durable and flexible belt, with great driving power.

Referring to Fig. 1 it will be seen that the belt passes from the sheave *F* on the driving shaft at the rear of the machine over the idler pulleys *C*, *B* and *A* to the sheave on the cutter spindle. The idlers *A* are attached to and moved with the cutter head; the idlers *B* are mounted on the end of a curved arm extending from the back of the column; and the idlers *C* are used for take-up purposes, being mounted on a movable block which slides freely on two upright rods.

In order to secure proper tension on the belt, after setting

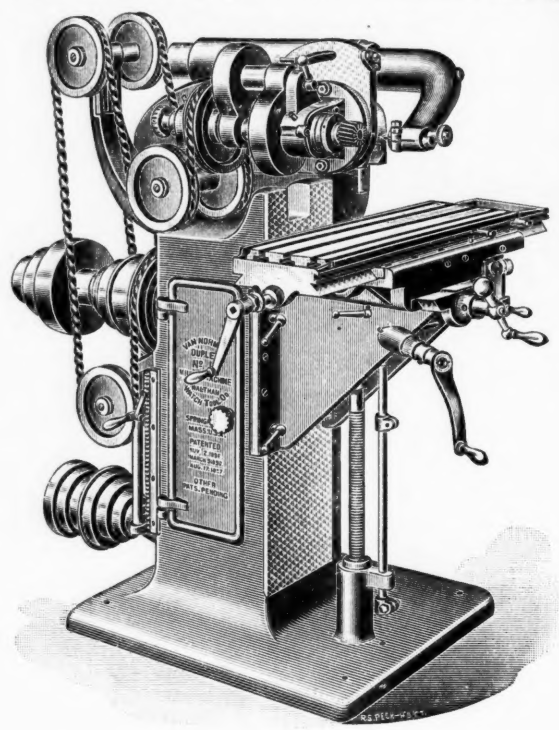


Fig 2.

the cutter spindle in the desired position, a ratchet lever *E* with pawl-locking device is provided. This lever is hinged to the inner face of the sliding block on which the take-up idler pulleys are mounted, and moves up or down with the block.

On the back of the column is a hooked rack for engage-

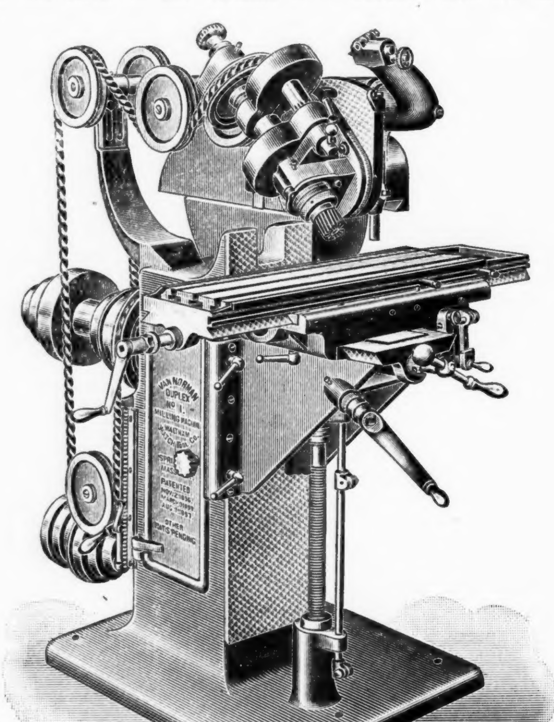


Fig. 3.

ment with the inner end of the lever, and a second rack on the outer face of column serves for engagement with the latch or pawl near the handle of lever *E*. The lever has a sliding movement on the fulcrum pin, and by disengaging the pawl and drawing the lever out of engagement with the

rack at the back of the machine the lever is free to move up or down with the sliding block or idlers. It can then be almost instantly pushed into engagement with the hooked rack and pressed down to get the desired tension on the belt, and the small pawl then pressed into the side rack to secure the lever in position.

For releasing the lever, when it is desired to change the position of the cutter spindle, the lever *E* is pressed down till the pawl can be released and the lever then pulled out of engagement with the rack at back.

The cutter head is provided with back gears, and the arrangement of the parts and the method of driving are such that speeds varying from 30 revolutions of the cutter spindle for heavy work, to 1,500 or 2,000 for light cuts, with small diameters of cutters, are obtained. The spindle is hollow, and has a draw-in spindle for holding milling cutters or spring collets, this arrangement doing away with the necessity for driving taper collets in or out of the spindle. The fact that the cutter head is on a slide which moves out or in makes it possible to use the cutter inserted in the end of the spindle and close to the point of support for nearly all work. In case, however, an outer support should be desired where an unusually long cutter is used or where for any reason it might be desirable to employ an arbor, there is an overhanging arm provided, as in Fig. 2. Fig. 3 shows the cutter head at an angle, and this feature of the machine which enables the head to be set at any desired angle enables a large class of work to be done with a common end and side mill, which would ordinarily require an angle mill.

The machine is solidly built, weighing 1,900 pounds, and is known as the No. 1 Van Norman duplex milling machine. The movement of the slides is as follows: Longitudinal feed of table, 22 inches; crossfeed in and out from the column, 8½ inches; vertical movement, 19 inches; movement of ram, 9 inches. The company are preparing full universal centers for all kinds of index milling, spiral cuttings, etc., these parts being constructed so they can be operated on the regular machines without swiveling the saddles of the machine.

* * *

HOW AND WHY.

A DEPARTMENT INTENDED TO CONTAIN CORRECT ANSWERS TO PRACTICAL QUESTIONS OF GENERAL INTEREST.

Give all details and name and address. The latter are for our own convenience and will not be published

The following inquiries have been received from different readers, and as they can undoubtedly be answered more fully by those who have special experience in these various lines of work than we could answer ourselves, we will submit them to our readers and trust that those who can do so will give the desired information. The questions are as follows:

F. F. K.: How are the teeth in hack-saw blades made?

J. H. C. (England): Please give me directions or a receipt for hardening twist drills. We have our own method for doing this but unfortunately find that sometimes the drills will not stand up to their work.

W. W. U.: How can I rig up an engine lathe to cut a groove in a cylindrical cam. It is to be a regular motion cam with the groove turned on the surface of a cylinder. The groove must be square with the surface, or, in other words, the same as a square thread; but it must be right-handed half way around, and left-handed on the other half of the cylinder—the pitch being 1¼ inch. I would like to be able to make a fixture to go on the lathe, without a great deal of expense.

C. L.: Please inform me how I can turn up circular-forming cutters from ½ inch to 1¼ inch face and get a smooth surface. I make my master tools very carefully but have some difficulty in getting them to cut. They will cut all right for a while and then refuse to cut, simply burnishing the steel. I use good lard oil, but still am not successful. The cutters are 2 inches in diameter and have a ½-inch hole with left-hand thread.

[If the machine is not stiff enough to hold the cutting tool up to its work there is likely to be trouble such as you outline. Also if the steel used in the cutter is not suitable the edge may wear off, destroying the clearance. As you have doubtless looked out for these features we would like to have our readers give their experience. We will also refer you to Mr. Woodworth's article on the first page of this number, in which an effective type of forming tool is described, and to page 38 of the October, 1900, number of MACHINERY, which contains a little information about the subject.—EDITOR.]

10. A. E.: I am making a steel T-square, using band steel for the blade, which is 2½ inches wide and 3 feet long. I would like to know how to bronze it to prevent rusting. Will it be necessary to grind and finish the faces before bronzing?

A.—A rust-resisting black bronze is said to be produced by a mixture of potassium sulphide, 1 part; ferric chloride, 10 parts; and water, 200 parts. The article to be bronzed is dipped in the solution and dried as many times as may be necessary to produce the color and depth of bronzing desired. The blade may be given a lustrous black color which will resist rust to quite a degree by immersing it in a hot mixture of 1 part black oxide of manganese and 10 parts saltpeter. In either case the blade should be brightly finished and perfectly free from grease or the perspiration of the hands. A patented process for making steel and iron rust-resisting consists essentially in heating the parts to a red-hot temperature in the presence of steam. The result is a blue-black surface that resists rust to a most remarkable degree.

11. O. G. M.: I would like to know how cold-rolled steel is blued such as that from which buttons are made. Is it done by acids?

A.—We are not familiar with the work to which you refer, so cannot say how the buttons are blued. In general, however, small steel and iron pieces are blued by heating them in sand, wood ashes, or powdered charcoal. An iron vessel is used to hold the articles and is heated over an open fire. The mixture of sand and pieces to be blued is stirred until the desired color is obtained. Sand gives a light blue and charcoal a dark blue. It is probable that the buttons to which you refer are treated in some way which will make them rust-proof, which is not a characteristic or ordinary bluing, although articles thus treated do not rust so readily as when left bright. Read answer to Question 10.

12. A. D. M.: When tempering steel after hardening is it better to draw the temper by dipping in linseed oil and drawing over the fire, or by placing the articles on a piece of hot iron?

A.—Articles of thin material, like springs, which require a spring temper, are frequently treated by dipping in oil and then burning off the oil over a fire. Blacksmiths adopt this method instead of trying to temper by watching the color, as it is found that it subjects the piece to just about enough heat to produce the desired results. In the case of thicker pieces, however, like tools, it is much better to use the hot iron and watch the color. The temper can thus be drawn to just the point desired and the steel will be tempered more uniformly both on the outside and inside than when the other method is used.

13. F. A. R.: According to the formulas for calculating the power of belting the arc of contact is taken as a factor, and in the case of a belt running over a very large pulley and a very small one—say, 48 inches and 8 inches respectively—the supposition is that the larger pulley will hold the belt while it slipped on the smaller one. In practice, however, I find this to be different. In nearly all cases the belt seems to slip on the larger pulley. Why is this?

A.—It is possible that in the cases that you have observed the surfaces of the smaller pulleys have been rougher than those of the larger pulleys, or have been of different material. Our experience is that the belt will ordinarily slip on the smaller pulley. This is certainly the case on the driving cones of machine tools, and if it were not the case the remedy for a slipping belt would naturally be to adopt smaller instead of larger pulleys, which manifestly is contrary to experience. It is well known, moreover, that increasing the arc of contact by a binder pulley tends to prevent slipping, which is also contrary to the instances that you have observed.

* * *

The first issue of the American Blacksmith, published at Buffalo, N. Y., has been received. It is a practical publication for blacksmiths and is well worthy of their support.

NEW TOOLS OF THE MONTH.

Under this heading are listed new machine and small tools when they are brought out. No tools or appliances are described unless they are strictly new and no descriptions are inserted for advertising considerations. Manufacturers will find it to their advantage to notify us when they bring out new products, so that they may be represented in this department.

Fay & Scott, Dexter, Me., are remodeling their line of engine lathes, their 32-inch lathe being so far the last one changed over. The bed has been made deeper and heavier and is mounted on cabinet legs of neat design. The headstock has been strengthened and improved by a larger spindle and larger bearings. The new carriage is made very wide, is provided with generous bearing surface on the V's and is strongly reinforced in the waist. The tailstock is provided with a pinion for moving it easily along the bed. The center rest has also been redesigned to be a fitting accompaniment to the remainder of the machine.

The two-spindle drill built by the Geo. Burnham Company, Worcester, Mass., described in the June, 1901, issue, is now made of the same design with from five to ten spindles, as may be required. This tool is a sensitive drill with independent drive for each spindle and is provided with automatic feed for each, if desired. The feature of the tool is that no quarter-twist bolts are used, the belting being direct between the cones. The cone spindles driving the drill spindles are all driven by one horizontal shaft through bevel gears. One gear of each pair of bevels is a fiber gear which reduces the noise to a minimum. The horizontal shaft is provided with a tight and loose pulley for the belt from the countershaft.

IMPROVED BORING MILL TABLE CHUCK.

A chuck adapted to heavy work and especially for boring machines has been designed and is being placed on the market by the D. E. Whiton Machine Company, New London, Conn. An important feature of the chuck is that the mechanism is inclosed so that dirt and chips are excluded from the working parts, which is most desirable on a vertical spindle machine. The jaws are both universal and independent in movement. The screw giving the independent

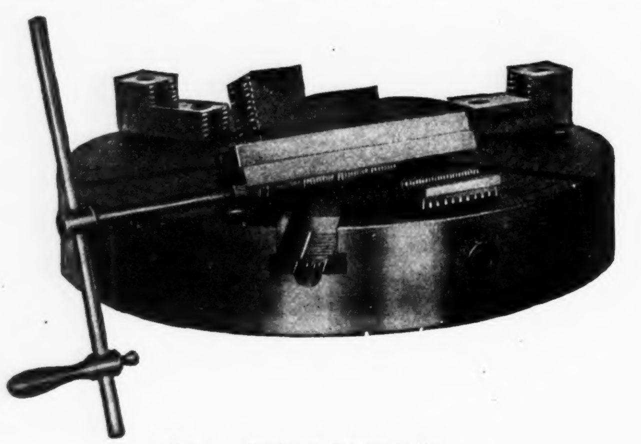


Fig. 1. Chuck for Boring Mills.

movement to the sliders, has multiple thrust shoulders (four in all), which divide the thrust and thus reduce the end wear to a minimum. The adjustable jaws are reversible on the sliders and may be clamped in any position in their length or may be removed entirely. The preferred construction of these chucks for boring mills is that of mounting them on a flange which forms an enlarged part of the machine spindle. In this manner the stiffest possible drive is acquired.

IMPROVEMENTS IN DRESES, MUELLER & CO. SIX-FOOT RADIAL DRILL.

In the May, 1901, issue one of the new line of radial drills built by Dreses, Mueller & Co., Cincinnati, Ohio, was illustrated and described. The machine shown herewith is substantially the same tool, the construction of the column and driving mechanism being unaltered, the changes being in the head. In the improved drill the spindle speeds are changed by shifting the knurled sleeve *A*, which may be done with the machine running. By moving the knobbed handle *B* up or down, the feed is disengaged or engaged. When the feed is to be thrown out automatically, the dog *D* is set at a point on the spindle sleeve corresponding to that at which the feed is to stop. When the desired point is reached the

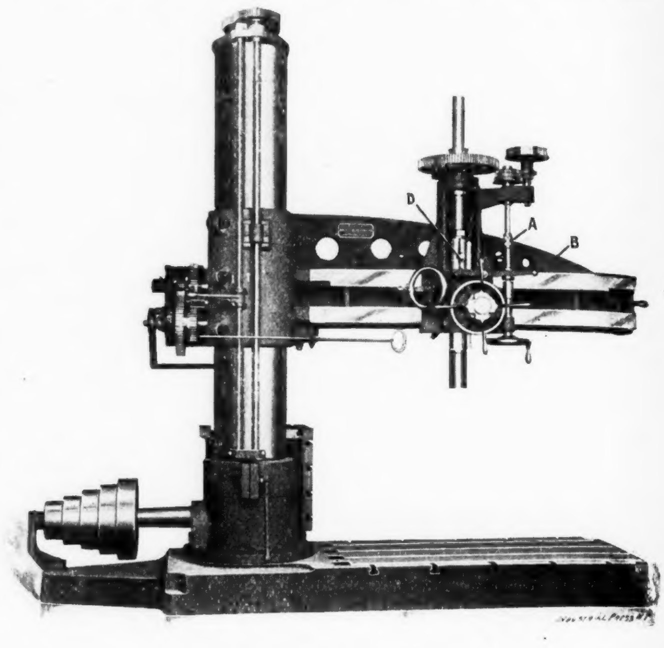


Fig. 2. Improved Radial Drills.

dog has thrown the knobbed lever upward at its outer end and has thus stopped the feed. Each of the four handles of the pilot wheel disengages the clutch between the power and hand feed, so that the spindle may be quickly returned to its upper position by the same pilot wheel. The spindle is counterbalanced by a guided weight and the head is moved on the radial arm by a spiral pinion.

HAND BORE KEYSEATER.

The machine shown in the illustration is a hand bore keyseater made by John T. Burr & Son, Kent Avenue and South Sixth Street, Brooklyn, N. Y. It is designed for cutting straight and taper keyseats in pulley hubs up to 1½ inches wide and 12 inches long. The machine, which, as its name implies, is designed for hand power, is mounted on a

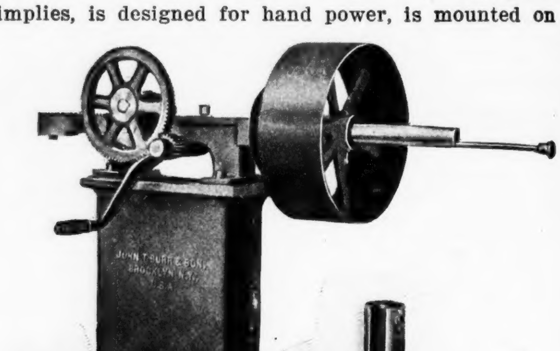


Fig. 3. Hand Bore Keyseater.

pedestal for ordinary work. For heavy work it is removed from the pedestal and directly attached to the piece to be keyseated. Since the machine is chucked to the bore and not to the face of the hubs, the latter need not be faced. The work is mounted on the mandrels shown in the cut, which have grooves cut longitudinally for the reciprocating cutter bar. The cutter is thus backed up in the most rigid

manner, which prevents chattering and inaccurate work. The cutter bar consists of two parallel strips firmly held together at one end, but free to be sprung apart at the other. One strip carries the cutter and the other bears against the back of the groove. The adjustment for successive cuts is obtained by a wedge which forces the two strips apart and which is operated by a long screw with a handle projecting outward beyond the bore of the work. The first pinion and rack of the machine are cut from machinery steel and all the gears are machine cut.

IMPROVED DRIVE FOR PROFILING MACHINES.

The Garvin Machine Company, New York, have adopted the Wesson system of driving for their line of profiling machines because of its marked advantages for this service. There are no belts on the machine to trouble the operator, which makes its construction very simple and operation easy. High speeds may be attained without vibration due to belt lacings passing over the spindle pulleys. The movement of the spindles is perfectly free and unimpeded by belts or sliding feathers. The accompanying cut shows the

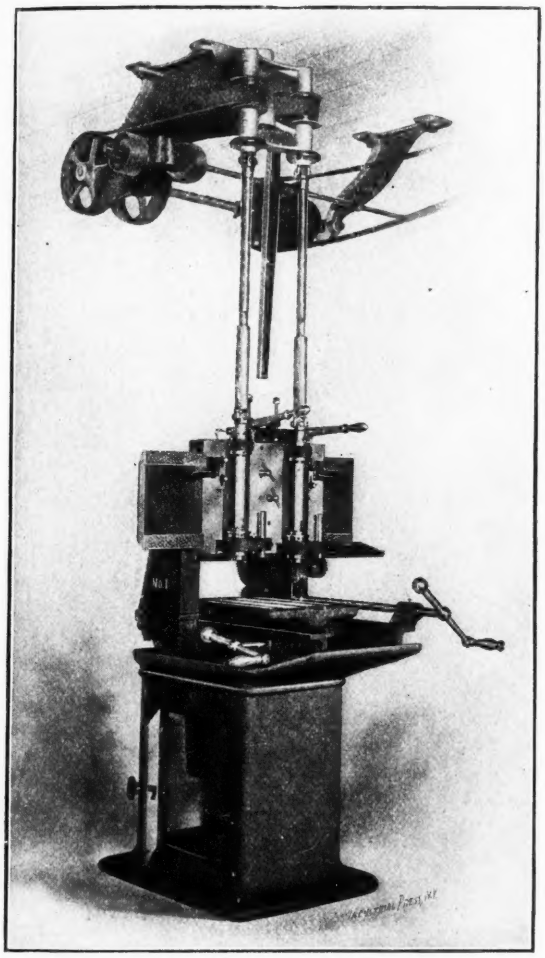


Fig. 4. Improved Drive for Profiling Machines.

salient features of the Wesson system. It consists of a countershaft with pulleys driving vertical shafts by means of quarter-twist belts. The vertical shafts connect with the profiler spindles by universal joints and telescopic connections which are so constructed that the motion is transmitted at a uniform angular velocity. The universal joints used are made from machinery steel and the pins of hardened steel. The pins are tapered and fit in tapered holes in the central pin-block and are adjustable, so that wear is readily taken up. Being locked by jam-nuts, loosening is prevented. The pin-block has a central hole packed with felt, for oil. The oil is thrown by centrifugal force outward around the tapered pins, insuring a constant lubrication. The vertical spindles may be run in the same or opposite direction, provision being made for the reversal of the direction of rotation. The profiler shown in the cut is the No. 1 size with two spindles. The two spindle machine is made in a larger and smaller size, the three sizes covering the range of small irregular work like that for typewriters and pistols to the heavy cam cutting. The advantage of the two-spindle machine is that work may be roughed out with one spindle and finished with the other at one setting.

IMPROVED SELF-CLOSING OIL CUP.

There is always an opportunity for improvement in the line of small machine details as well as in the larger parts of machinery. The old habit of building a new machine and leaving the oil holes open to catch dust, dirt, etc., is fast being done away with. The Winkley Co., of Hartford, Conn., were pioneers in the manufacture of a dust-proof cover for protecting the oil holes of machinery. Their design was such that they could be cleaned easily before opening, and they were self-closing. They also served the purpose of showing the operator the location of the oil passages needing atten-

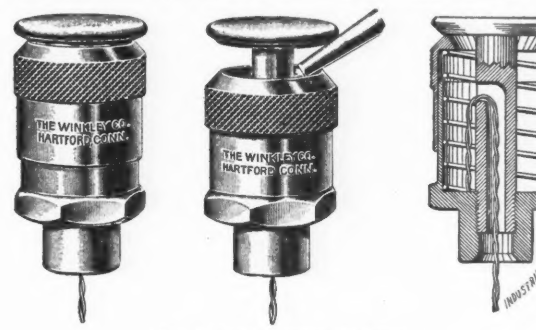


Fig. 5. Self-closing Oil Cups.

tion. An improved oil cup has now been brought out by this company, shown in the views in Fig. 5. It is self-closing and has a reservoir for continuous feed. The oil cup is made so that it can be screwed or driven into position. It can be opened by the fingers by depressing the outer knurled ring, which is ordinarily held in its extreme upper position by the spring shown in the sectional view. It can also be easily opened by the nozzle of the oil can, as shown in the central figure. The reservoir is self-feeding by a wick or a wire, or wool can be used in the reservoir by changing the location of the feeding hole.

IMPROVED LATHE CLAMP DOG.

When the ordinary lathe dog is used on finished work it is necessary to interpose a piece of some soft substance between the end of the screw and the work, to prevent marring. Quite often the time consumed in hunting up a piece of copper for this purpose makes an annoying delay on a job. To make unnecessary this trouble and to make a dog which will hold equally well on all classes of work, H. H. V. Lilley, Milford, Mass., is manufacturing the lathe clamp dog shown in the accompanying cut. As will be seen there is a die-block interposed between the end of the screw and the work. The block is soft on the face presented to the work and hard on the back against which the screw abuts. A pin is set in the back of the block which enters a hole drilled in the end of the screw. The pin prevents the block falling out of place. The shape of the opening in the block is such that the work is firmly held without putting a heavy strain on the screw The dog is adapted to holding both rough and finished work, whether round, square or of other cross-section shape.

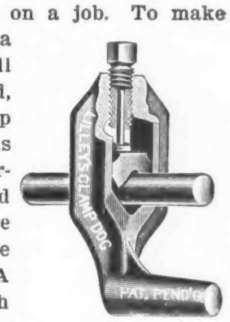


Fig. 6.

A SMALL SURFACE GRINDER.

The Diamond Machine Company, Providence, R. I., have brought out a small surface grinder that contains some points of interest. The requirements were:

1. Dust proof and self-oiling bearings which would be larger than ordinary and provided with a take-up for wear.
2. Means for quickly changing the emery wheels so that different sizes, shapes and grades can be used without loss of time for truing up.
3. A table with a coarse and a fine vertical adjustment, the former to be quickly made.
4. Provision for an ordinary emery wheel at the back end of the spindle.

5. Ample weight, or rather mass, so as to absorb vibrations and permit accurate and nicely finished work to be done.

In Fig. 7 is the machine assembled, showing an auxiliary table attachment provided with a longitudinal lever movement, and a transverse screw adjustment.

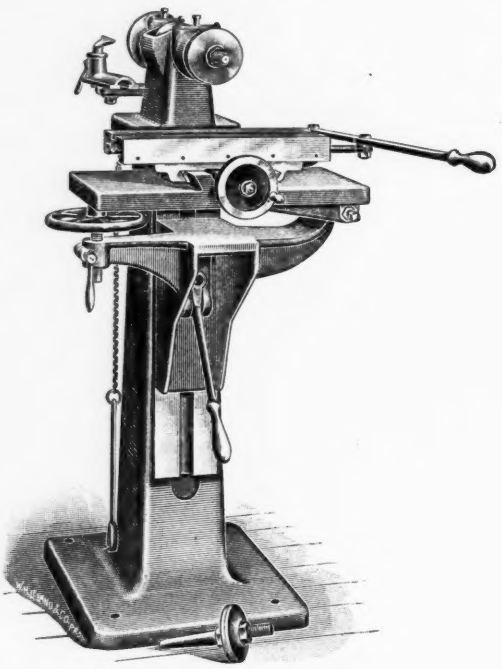


Fig. 7. Small Surface Grinder.

Fig. 8 gives a section through the head, and, together with Fig. 9, shows how requirements one, two and four were fulfilled. The bearings are babbitted and have oiling rings. The front bearing is tapered to compensate for wear and the thrust adjustment is accomplished in an unusual way.

It was desired to have a minimum overhang, so the nut

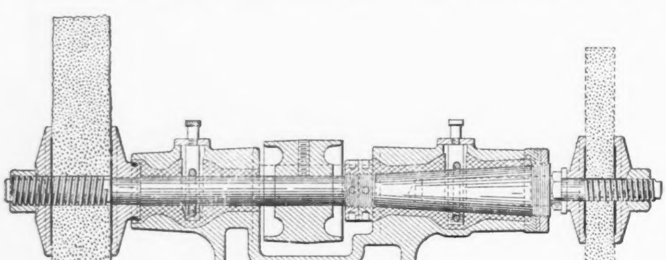


Fig. 8. Section through Head.

and collar were therefore made quite thin. The nut has eight radial keyways, one of which fits over a radial key on the collar, and this key also extends inwardly into a keyway in the spindle. The nut is thus positively prevented from turning and does not depend upon friction.

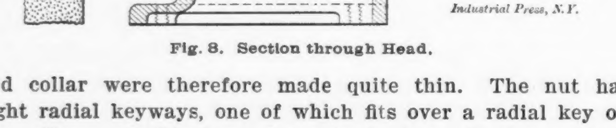


Fig. 9. Spindle and Thrust Bearing.

Requirement two is met by mounting the emery wheels on small arbors having taper shanks fitting into a taper socket in the spindle. Requirement three is met by having the knee counterbalanced by a weight within the column, by using a quick-acting cam clamp, and by having the fine adjustment made by a screw and large handwheel.

ELECTRICALLY-DRIVEN YANKEE DRILL GRINDER.

The Wilmarth & Morman Co., Grand Rapids, Mich. have brought out an electrically-driven model of the Yankee drill grinder which is adapted to wet grinding. The motor is mounted on the same spindle with the grinding wheel, so the connection is direct without belting and is inclosed in a dust-proof case. It is compound-wound and its starting-box is conveniently located in the column of the machine. The grinding wheel is supplied with water by a centrifugal pump and the whole grinding face is flooded with water so that there is little possibility of drawing the temper of a drill with ordinary care, even when grinding heavily. The water from the wheel hood is returned to the tank by a rubber pipe. The tank has a settling space into which the grinding debris settles before the water is again drawn into the pump. The bearings are protected from wet and grit so that the life of the machine should be as long as a dry grinder with the advantage of doing better and faster work. The machine has a capacity for twist drills from 1/4 inch to 3 1/4 inches and weighs complete about 500 pounds. The small amount of water which trickles down the bottom of the Vee is also returned to the tank by a rubber pipe attached to the lower end.

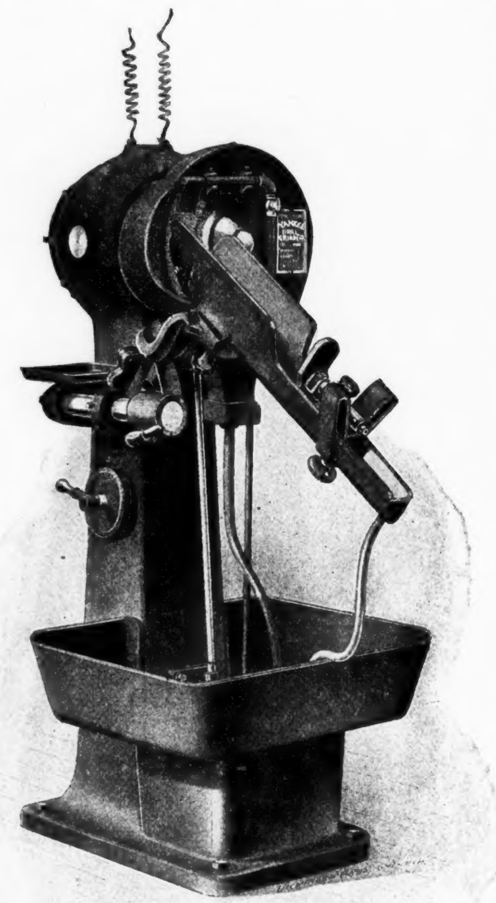


Fig. 10. Electrically Driven Grinder.

OSTER PIPE MACHINE.

The pipe machine, Figs. 11 and 12, is designed for cutting and threading 1-inch and 6-inch pipe. It is set on a heavy base which is of such a height that the center of the pipe comes about 30 inches from the floor. This height makes the handling of the larger sizes of pipe easier than if either higher or lower. The base carries an oil tank from which the oil is pumped on to the dies or cutting-off tool when in use. The oil tank is provided with a drainage cock for convenience in cleaning. The vise holding the pipe is of original design, the object being to clamp the pipe without great effort on the part of the operator and to center the pipe absolutely accurate with the dies in order to insure perfect threading. The vise carrying the pipe is fed forward to the dies by a rack and pinion driven by a handwheel. The die head is of the Oster standard form, the dies being removable outwardly through the head, which makes changing for

different sizes or for blank dies when cutting off, convenient. The cutting-off tool is operated by a star-wheel mounted on the die head. By this arrangement a smooth and powerful action is obtained which enables the pipe to be cut off rapidly

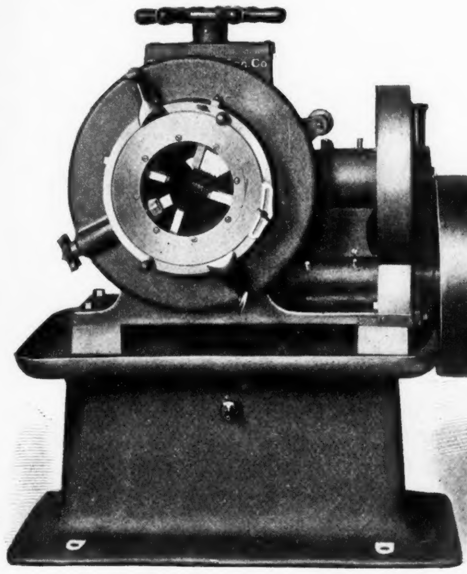


Fig. 11. Front of Pipe Machine.

and with an entire absence of burr, and without destructive effect on the cutting tool. The gearing is entirely inclosed, making the tool a safe one for general use. The total weight of the machine is 1,300 pounds.

NEW WORCESTER DRILL GRINDER.

The Washburn shops of the Worcester Polytechnic Institute, Worcester, Mass., exhibited at the Pan-American Exposition a new model of their drill grinder which is peculiarly adapted to wet grinding. As shown in the cut of the wet

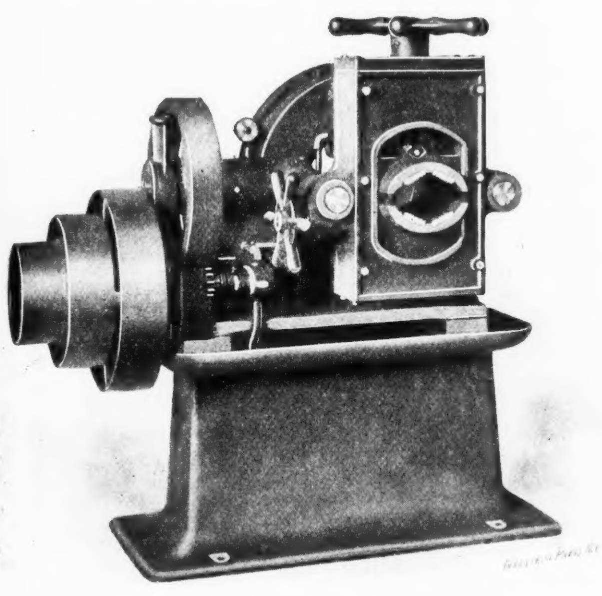


Fig. 12. Rear of Pipe Machine.

grinder, the drill holder is inclined to the face of the grinding wheel, so that the shank of the drill is higher than its point. Instead of applying water to the wheel it is applied to the drill itself, from whence it runs to the face of the wheel. The water floods the drill point before acquiring the velocity of the revolving wheel, consequently has much more cooling effect than when spattered on the drill point from the wheel in the usual manner. As the water acquires the velocity of the wheel it is thrown by centrifugal force into a reservoir attached to the upper part of the wheel case, from whence it again flows down onto the drill. In this way the use of a pump, with its attendant troubles, is avoided.

The drill holder correctly holds drills from ¼ inch to 2¼ inches in diameter without making any preliminary adjustment whatever. Any drill between the limits of diameter mentioned may be laid in the holder without adjusting it to the diameter or length. A new form of lip rest automatically determines the exact position of the drill point relative to the grinding wheel, irrespective of the drill's diameter or length. A foot stop is provided for grinding flat and irregularly-shaped drills.

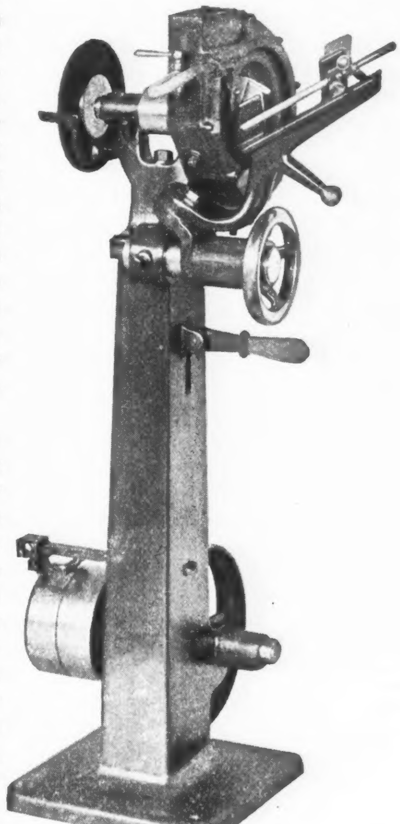


Fig. 13. Wet Drill Grinder.

The same model is made for dry grinding and driven by an air motor placed in the base of the machine. When the machine is thus driven, advantage is taken of the exhaust from the motor for cooling the drill points. A bench size of the dry grinding machine in the new model is also built, which is adapted to drills ranging from ½ inch in diameter down to the smallest in use. This model also holds the drills automatically in the drill holder, the same as in the larger sizes. The holder is also provided with the micrometer feed for advancing the drill holder to the face of the grinding wheel.

THE FARWELL DRILL GRINDER.

The efficiency of a milling cutter depends on the sharpness of its teeth. To make each tooth do its full share of the work, it must not only be sharp, but all must be of the same radial distance from the center. The surest manner of getting this condition is to grind the cutters on the work arbor. For grinding milling cutters in working position the Adams Company, Dubuque, Iowa, make a cutter grinder which is particularly adapted to grinding the cutters of the Farwell

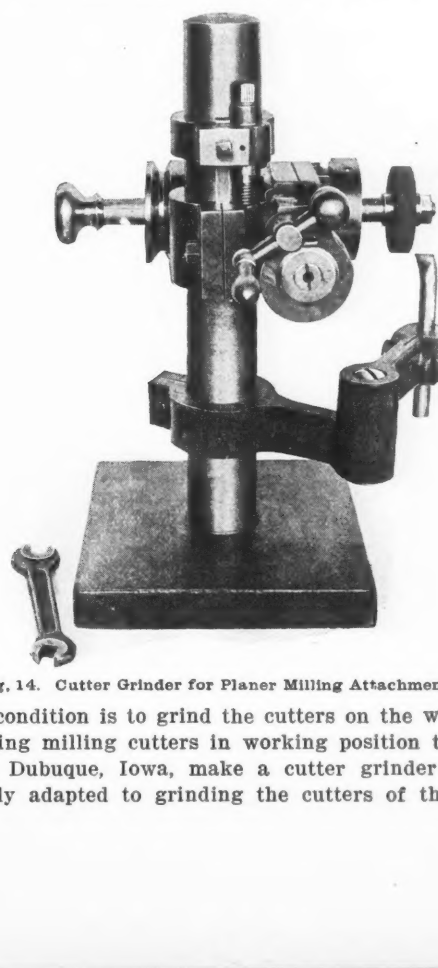


Fig. 14. Cutter Grinder for Planer Milling Attachment.

milling machine for iron planers, made by them. The grinder has a base which is clamped to the table of the machine. The wheel is driven by a round belt either from the milling countershaft, or, preferably, from a separate countershaft. The grinding wheel may be swiveled to grind the sides and face of any straight tooth cutter without removing the cutter from the spindle. The grinder spindle takes ¾ x 6-inch wheels with ½-inch hole. It has an end adjustment by hand of 2 inches and by screw of 1½ inches. The total weight of the grinder is 60 pounds.

* * *

"A rolling stone gathers no moss" may be a safe motto for some people to heed, but the mechanic who never bestirs himself from one shop, is quite certain to gather more "moss" than experience as was aptly put by a writer in MACHINERY some years ago. A Basuto saying is the converse of the old proverb quoted, being "A sitting hen never gets fat." There is nothing like getting into a new atmosphere to sharpen the wits and awaken self-reliance. If a man has the stuff in him, it will come to the surface and he will be the better for occasional changes from shop to shop as he will add to his store of shop lore in each place. If, however, he is not of a progressive nature, he had better stay in one place, since roving will only be likely to cause him to develop into a tramp.

* * *

FRESH FROM THE PRESS.

MECHANICAL DRAWING. By F. W. Bartlett, lieutenant-commander, U. S. N. Published by John Wiley & Sons, New York. 188 8vo pages; illustrated. Price $3.

There are so many textbooks upon mechanical drawing that there hardly seems to be need for another one. What is perhaps a reasonable excuse in this case, however, is that this book is written for the use of naval cadets at the U. S. Naval Academy, and so covers the standard methods used by the Navy Department in so far as is possible in a textbook. The drawings referred to for the general instruction are those of the Bureau of Steam Engineering of the Navy Department, and the methods of that bureau have been followed. The book does not go deeply into descriptive geometry. It treats on the use of the instruments, lettering, the various conventionalities of working drawings, and gives directions for drawing the practice sheets required in the course. There are directions for freehand sketching, and there is a chapter upon working drawings in which some of the more practical features are considered. The book is a thoroughly practical treatise on working drawings and will be preferred by many because of the standard methods taught.

ADVERTISING LITERATURE.

We have received the following catalogues and trade circulars:

THE FRANKLIN MACHINE WORKS, Philadelphia, Pa. Illustrated catalogue of horizontal boring machines, milling machines and cold saw cutting-off machines.

THE KEYSTONE DROP FORGE WORKS, Philadelphia, Pa. Circular of a safety shackle hook for use on cranes, etc., which does away with accidents from slipping or breaking of the hook.

THE STOW FLEXIBLE SHAFT CO., Philadelphia, Pa. Illustrated circular of electric portable drills and various other portable tools for drilling, tapping, grinding, etc.

THE FRANKLIN PORTABLE CRANE & HOIST CO., Franklin, Pa. Circular of small portable crane designed to be transported to any part of the shop, for handling castings of small and medium size.

THE PATTERSON TOOL & SUPPLY CO., Dayton, O., are now building their "Challenge" power hack saw so that it will handle 12-inch I-beams and channels. They are also selling a 4-inch machine.

WILLIAM G. LE COUNT, South Norwalk, Conn. Price list of machinists' tools, which include lathe dogs, clamps of various styles, expanding mandrels, adjustable blocking and jack screws for use on the planer, drill press, etc.

THE E. W. BLISS CO., Brooklyn, N. Y. Catalogue of drawing presses and spinning lathes. The largest of these is the Bliss toggle-joint press, which is for the heaviest class of drawn sheet metal work. A great many intermediate and small size presses are also shown.

THE THURSTON MFG. CO., Providence, R. I. Illustrated circular of special machines for jewelers' and diemakers' use. These include an inverted milling machine for blanking and trimming dies, a filing machine for work done upon dies, a price list of metal saws, milling cutters, etc

A. L. HENDERER'S SONS, Wilmington, Del. Catalogue of hydraulic jacks and boilermakers' specialties, such as tube expanders, steel screw punches, hydraulic punches, hydraulic jacks and pressure pumps. Also a circular of malleable iron pipe vises.

THE WASHBURN SHOPS, Worcester, Mass. Supplementary catalogue of the Worcester drill grinders, in which are illustrated a few of the more recent machines, including the wet grinders. At the back of the catalogue is a complete tabulated list of their full line of machines.

FOOTE, BURT & CO., Cleveland, O. Illustrated catalogue of multiple spindle drills. Several new types of these machines have been brought out recently. Of these may be mentioned a new universally adjustable automatic multiple spindle drill, as representing one of the latest designs for manufacturing purposes.

THE PRENTICE BROS. CO., Worcester, Mass. A neatly illustrated pamphlet entitled "Our Shops and Some of the Products." This booklet contains no descriptive matter but a good idea of the extent of the works and the variety and character of the drills and lathes manufactured can be obtained from the illustrations. There is a view of their Pan-American exhibit and nearly all of the machines illustrated are electrically driven.

THE B. F. STURTEVANT CO., Boston, Mass. Catalogue No. 117 of the Sturtevant electric motors, generators, and generating sets. In the introduction it is stated that this company have patents for over 100 sizes and types of engines and that their motor and generator designs are made in correspondingly great variety. The catalogue is in the usually attractive style of those issued by this company. We have also received catalogue No. 118 of the steam and hot blast heating and drying apparatus.

HAMMACHER, SCHLEMMER & CO., 209 Bowery, New York. Catalogue of tool outfits for home use. This is one of the most attractive catalogues recently issued. In it are listed a large number of outfits of tools intended for those who wish to have a good assortment of tools at hand for such work as is ordinarily done about the house. These outfits cost from $5 to $85 each, the more expensive ones including a work bench and cabinet. Even the cheapest outfits, however, are contained in a case where the tools can be kept together.

THE AMERICAN SCHOOL OF CORRESPONDENCE, Boston, Mass. Handbook of the technical correspondence courses in electrical, mechanical, stationary, marine and locomotive engineering; textile work; and heating, ventilating and plumbing. This gives complete information about the school, its instructors, the courses of instruction and the methods followed by the instructing staff in correcting papers and otherwise assisting the students. There are also sample pages of the papers. The list of subjects for each course is given in full.

THE KEMPSMITH MFG. CO., Milwaukee, Wis. Catalogue of horizontal milling machines. There are five types or sizes of plain milling machines shown, and four universal millers. These are mostly of the knee type, but there is one—a plain miller—of the Lincoln type. They are all of new and improved design and there are several attachments such as for vertical and circular milling. The cuts, make-up and press work of the catalogue are such as to make a bit of trade literature that will attract attention.

THE PRATT & WHITNEY CO., Hartford, Conn. Catalogue of small tools, standards and gages. This is virtually a new catalogue from cover to cover, all the cuts being new half-tone engravings of the best quality. The previous catalogues of this company have been considered by machinists as standard reference books, in view of the practical information contained, and this new catalogue is destined to be even more valuable in this respect. It contains descriptions of a number of new tools brought out during the past year, and is a catalogue that all machinists will appreciate.

THE SPRINGFIELD MACHINE TOOL CO., Springfield, O. Illustrated catalogue of a complete line of engine lathes from 42-inch swing to 14-inch swing, and of crank shapers. The lathes manufactured by this company include both the well-known Springfield Muller engine lathes and the new Ideal lathes recently described in our columns. The feature of the new lathe is the new arrangement of the feed gears for effecting feed changes easily and rapidly without removing parts held by nuts and washers. Several sizes of turrets and turret lathes are also shown.

CONTENTS FOR NOVEMBER.

MANUFACTURERS' NOTES.

THE BURT MFG. CO., Akron, O., report the receipt of two important orders for Cross oil filters from German manufacturers.

THE LUNKENHEIMER CO., Cincinnati, have been awarded the gold medal for their valves, lubricators and engine-fittings, at the Pan-American Exposition.

THE CLEVELAND TWIST DRILL CO., Cleveland, O., announce that they have been awarded the gold medal at the Pan-American Exposition.

THE BUFFALO FORGE CO., Buffalo, N. Y., have received two gold medals and a silver medal for excellence of apparatus exhibited in the machinery exhibit at the Pan-American Exposition.

THE W. P. DAVIS MACHINE CO., Rochester, N. Y., are about to bring out a new 36-inch and also a 42-inch triple-geared engine lathe of massive design and thoroughly up-to-date, which they expect to have ready in about three months.

MR. J. I. LYLE, M. E., who has been connected with the home office of the Buffalo Forge Company for the past five years, is now manager of the New York Branch, No. 39-41 Cortlandt St.

THE L. S. STARRETT CO., Athol, Mass., announce that, for the better service of the western trade, they have opened a store at South Canal St., Chicago, where a full stock of Starrett tools will be kept. Capt. Al. T. Fletcher is manager of this branch.